

# OPERATIONS AND MAINTENANCE MANUAL

Volume 1 - Operations and Maintenance  
Plan/Contingency Plan for Perimeter  
Groundwater Containment System and Barrier  
Wall and Associated Extraction System

AMERICAN CHEMICAL SERVICE, INC.  
NPL SITE

GRIFFITH, INDIANA

JULY 1997

US EPA RECORDS CENTER REGION 5



463684



**MONTGOMERY WATSON**

August 8, 1997

United States Environmental Protection Agency  
Region V (HSRL-6J)  
77 West Jackson Blvd.  
Chicago, IL 60604-3590

ATTN: Ms. Sheri Bianchin

SUBJECT: PGCS/BWES Operations and Maintenance Plan  
American Chemical Service, Inc. Superfund Site  
Griffith, Indiana

Dear Ms. Bianchin:

Enclosed is a copy of the Operations and Maintenance Plan for the PGCS and BWES facilities. I will be forwarding four additional copies to you, as well as five copies to IDEM and two to Black & Veatch, early next week. If you have any questions please feel free to contact Peter Vagt or me at your convenience.

Sincerely,

**MONTGOMERY WATSON**

Ron J. Schlicher  
Engineering Manager

Enclosure

cc: Peter Vagt



**MONTGOMERY WATSON**

August 12, 1997

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**AMERICAN CHEMICAL SERVICE INC. NPL SITE**

**OPERATIONS AND MAINTENANCE MANUAL  
FOR THE  
PERIMETER GROUNDWATER CONTAINMENT SYSTEM  
AND THE  
BARRIER WALL AND ASSOCIATED EXTRACTION SYSTEM**

- |                 |   |
|-----------------|---|
| <b>VOLUME 1</b> | <b><i>OPERATIONS AND MAINTENANCE PLAN/CONTINGENCY<br/>PLAN FOR THE PGCS AND BWES</i></b>  |
| <b>VOLUME 2</b> | PERFORMANCE STANDARD VERIFICATION PLANS<br>A. PGCS PSVP AND QAPP<br>B. BWES PSVP AND QAPP |
| <b>VOLUME 3</b> | CONSTRUCTION COMPLETION REPORT/COMPLETION OF REMEDIAL<br>ACTION REPORT                    |
| <b>VOLUME 4</b> | AS-BUILTS FOR THE PGCS AND BWES   |
| <b>VOLUME 5</b> | EQUIPMENT MANUFACTURER'S MANUAL<br>INSTRUMENTATION AND CONTROL EQUIPMENT                  |
| <b>VOLUME 6</b> | EQUIPMENT MANUFACTURER'S MANUALS  |
| <b>VOLUME 7</b> | EQUIPMENT MANUFACTURER'S MANUALS  |
| <b>VOLUME 8</b> | EQUIPMENT MANUFACTURER'S MANUAL<br>UV OXIDATION UNIT                                      |

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## **1.0 INTRODUCTION**

### **1.1 PURPOSE**

This document is the Operations and Maintenance (O&M) Plan and the Contingency Plan for the Perimeter Groundwater Containment System (PGCS) and the Barrier Wall and Associated Extraction System (BWES) which were installed as expedited remedial actions at the American Chemical Service (ACS) Site in Griffith, Indiana. Construction of the PGCS was completed in the spring of 1997 and the BWES is expected to be completed in the summer of 1997. This document is Volume 1 of the overall Operations and Maintenance Manual for the PGCS and BWES. The O&M Plan provides the information necessary to operate and maintain the extraction and treatment facilities. The plan describes the overall systems, the anticipated groundwater characteristics, required effluent quality, and the process control, startup, normal operation, and shutdown of the equipment. The Contingency Plan portion of this document describes the procedures to be followed in case a spill or other discharge of waste materials or hazardous substances occurs during the course of operating and maintaining the PGCS and BWES facilities.

This plan is intended to be used in conjunction with the O&M manuals provided by the manufacturer's of the equipment, and as such, it does not focus on routine maintenance and calibration of standard equipment items. Reference to the manufacturer's O&M manuals (Volumes 5 through 8) is made throughout this plan, and it is therefore imperative that the operators become familiar with those documents as well.

### **1.2 MANUAL USE AND ORGANIZATION**

This O&M and Contingency Plan for the PGCS and BWES facilities is designed to provide the plant operator with proper background and procedures for day-to-day operation and maintenance of the treatment facility. The manual includes:

- An overall description of the extraction and treatment facilities
- A detailed description of the major extraction and treatment components and support systems

- Start-up procedures including water testing and actual start up of the PGCS treatment system with groundwater
- Individual equipment descriptions, identifying major components, procedures, process control provisions (where applicable), trouble-shooting, and preventive maintenance information
- Analytical program and record keeping and reporting
- Emergency response and contingency plan including the vulnerability analysis and alternate operations.

It should be emphasized that specific maintenance information on each piece of equipment is provided in the manufacturer's O&M manuals for the individual equipment which are included in Volumes 5 through 8 of this manual.

## **1.3 PROJECT BACKGROUND**

### **1.3.1. Site Description**

The American Chemical Service, Inc. (ACS) Site is located at 420 South Colfax Avenue in the City of Griffith, Indiana, which is in the northwestern corner of the state. The site is bordered on the east and northeast by Colfax Avenue. The Chesapeake and Ohio railway bisects the site in a northwest-southeast direction, between the fenced On-Site Area (north) and the Off-Site Area (south). On the west and northwest, south of the Chesapeake and Ohio railway, the site is bordered by the abandoned Erie and Lackawanna railway, and the active portion of the Griffith Municipal Landfill. North of the Chesapeake and Ohio railway, the site is bordered on the west by wetland areas. The northern boundary of the site is formed by the Grand Trunk railway.

There are five land disposal areas at the ACS Site: the On-Site Containment Area (ONCA), the Still Bottoms Pond (SBP) Area, the Treatment Lagoons, the Off-Site Containment Area (OFCA), and the Kapica/Pazmey Area<sup>1</sup>.

<sup>1</sup> The terms On-Site and Off-Site are used to denote particular portions of the ACS Site: both areas are within the CERCLA Site. The Off-Site Containment area is designated as off-site only because it is adjacent to, rather than within the boundaries of the property where ACS currently conducts its chemical formulation operations. However, ACS owns the property and as noted, for CERCLA purposes, both of these areas are considered on-site.

### 1.3.2. Operational History

Based on information provided by American Chemical Service, Inc., the ACS facility began operation in May 1955 as a solvent recovery facility. Solvent recovery remained the primary operation performed on-site through in the late 1960s, when the manufacture of small quantities of specialty chemicals began. These manufacturing operations included treating rope with fungicide, bromination and treating ski cable.

In 1961, ACS sold a two-acre parcel to John Kapica, and in 1962 Kapica began the operation of his drum reclaiming business at the location. Operations at Kapica Drum, Inc., consisted of drum reconditioning. Kapica Drum was sold to Pazmey Corporation in February 1980. Kapica/Pazmey operated from 1980 to 1987. The Pazmey Corporation property was sold to Darija Djurovic in March 1987.

ACS' solvent operations involved spent solvent mixtures containing alcohols, ketones, esters, chlorinated solvents, aromatics, aliphatics, and glycols. In the early years of operation, spent solvents were stored in 55-gallon drums at various locations at the Site. Solvent recovery was performed in batch evaporation units, which were charged by pumping material directly from 55-gallon drums into the evaporation vessels. Still bottoms from the evaporation vessels were disposed in the Still Bottom Pond, prior to the installation of incinerators at the facility. ACS installed its first incinerator in 1966 and installed a second incinerator in 1969. The incinerators were used to burn still bottoms and non-reclaimable materials generated at the site, and wastes from off-site. The incinerator units were dismantled in 1977.

From 1970 to 1975, the spent solvents reclaimed at the site were similar to those which were handled in the 1960s. However, an increasing percentage of shipments were received at the site in bulk tanker trucks. In addition, the batch manufacturing processes were expanded during this period. A lard oil process which utilized tallow and animal rendering was used to manufacture a lubricant product. This process, along with a soldering flux operation, was discontinued prior to 1990. In 1971, the additive manufacturing area was built. Various detergents lubricants, and chemical additives were manufactured, in addition to soldering flux, various amines, methanol, formaldehyde,

sodium hydroxide, and maleic anhydride. An epoxidation plant was constructed in 1974 and a bromination operation using hexane was added in 1975. At various times up until 1990, the epoxidation plant used toluene or benzene as a reaction carrier.

Some time between 1975 and 1990, the solvent distillation units were replaced with new units though the types of solvent wastes reclaimed remained essentially the same. Spent solvent and reclaimed solvent recovery tank farms were constructed during this time period and the majority of the spent solvent waste streams were shipped in bulk tanker trucks, although drummed wastes were still processed. A hazardous waste drum unloading dock and storage area were built in the early 1970s, with spill containment curbing and a sump area added at a later date. In September 1990, ACS ceased accepting hazardous waste shipments and filed for closure. On March 31, 1993 ACS completed closure and terminated its interim RCRA status. ACS currently operates as a chemical production facility at the site. The operations include chemical reaction processes, custom blending, and product distribution. The facility encompasses 8.5 acres with process buildings, tank farms, loading and unloading areas, a laboratory, offices, and support utility buildings. The company operates 24 hours per day, five to six days per week. The operating production facility is secured by a continuous fenceline with a single controlled access gate.

### **1.3.3. Land Disposal History**

When ACS began operations in 1955, the still bottoms from the solvent recovery operations were disposed of in the Still Bottoms Pond/Treatment Lagoon area. In 1972, the pond and lagoons were drained, and drums, partially filled with sludge materials, were landfilled there.

The OFCA was utilized for the landfilling of wastes including excavated materials from the Still Bottoms/Treatment Lagoon from 1958 to 1975. The waste types disposed of in the OFCA over the course of ACS' operations also included general refuse, drums, still bottoms and incinerator ash. According to the ACS, Inc. owner/operators, drums placed in the OFCA were crushed or punctured as part of the disposal process.

During the mid-1960s, it is estimated that approximately 400 drums of sludge and semi-solids were landfilled in the ONCA. Residual wastes and rinse waters from the

Kapica/Pazmey drum reconditioning operation were disposed of on the ground in the Kapica/Pazmey Area.

#### **1.3.4. Administrative History**

In February 1980, the U.S. EPA performed a Preliminary Assessment of the ACS Site, collecting samples in the Off-Site Containment Area and at the Griffith Municipal Landfill in May 1980. The U.S. EPA performed a site inspection on September 9, 1980, and in July 1982. U.S. EPA contractors installed four monitoring wells near the Off-Site Containment Area and the Griffith Landfill. Based upon information developed during these investigative efforts, a hazard ranking system score of 34.98 was assigned to the ACS Site by U.S. EPA in June 1983.

In 1986, a group of approximately 125 Potentially Responsible Parties (PRPs) formed a Steering Committee to conduct the Remedial Investigation/Feasibility Study (RI/FS) pursuant to an agreement with the U.S. EPA. The PRPs signed a Consent Order to perform the RI/FS in June 1988. Following U.S. EPA approval of the RI/FS Work Plan, the field investigation for Phase I of the RI began in July 1989. Phase II RI field work began in March 1990, and in December 1990, the Phase III RI field work was initiated. The RI report was completed in June 1991. Warzyn (now Montgomery Watson Americas, Inc.) completed the FS report in June 1992.

In June 1992, the U.S. EPA published notice of its Proposed Plan for Remedial Action for the ACS Site. The remedy presented in that Proposed Plan was described by U.S. EPA as a modification of Remedial FS Alternative 6B. The U.S. EPA issued a Record of Decision (ROD) in September 1992. The UAO was issued on September 30, 1994. The Respondents provided notice to the U.S. EPA of their intent to comply with the UAO, and have developed the planning documents and performed other tasks required by the UAO to date.

#### **1.4 SCOPE OF THE PERIMETER GROUNDWATER CONTAINMENT SYSTEM**

The remedy presented in the ROD for the ACS Site includes the following components:

- Groundwater pumping and treatment to dewater the site and to contain the contaminant plume with subsequent discharge of the treated groundwater to surface water and wetlands;



- Excavation of approximately 400 buried drums in the ONCA for off-site incineration;
- Excavation of buried waste materials and treatment by low temperature thermal treatment (LTTT);
- On-site treatment or off-site disposal of treatment condensate;
- Vapor emission control during excavation and possible immobilization of inorganic contaminants after LTTT;
- Off-site disposal of miscellaneous debris;
- In-situ vapor extraction pilot study of buried waste in the On-site Area;
- In-situ vapor extraction of contaminated soils;
- Continued evaluation and monitoring of wetlands and, if necessary, remediation;
- Long-term groundwater monitoring;
- Fencing the Site and implementation of deed and access restrictions and deed notices; and
- Private well sampling with possible well closures or groundwater use advisories.

During meetings held early in 1995 with the Respondents, U.S. EPA, and IDEM, the agencies expressed a desire to have some components of the remedy designed and constructed on an expedited basis. The Respondents expressed a similar desire and voluntarily agreed to expedite the design and construction of a groundwater collection and treatment system. The objective of the system is to prevent off-site migration of contaminants in the upper aquifer along the northwestern perimeter of the site. Consequently, it was called the Perimeter Groundwater Containment System or PGCS.

The PGCS is not intended to remediate the full extent of groundwater contamination, but it is an integral component of the overall remedy.

Since the PGCS is the first component of the overall remedy, it was designed with a high degree of flexibility such that it can easily be integrated with future components of the remedy. For example, the strategy for the site includes the installation of dewatering systems to control migration of contamination from the waste areas and to allow for pilot tests to be conducted in unsaturated material. Water extracted from the dewatering systems will need to be treated. Consequently, the treatment system for the PGCS was designed to handle waste area flows and to allow for easy expansion if necessary.

The PGCS includes the following components:

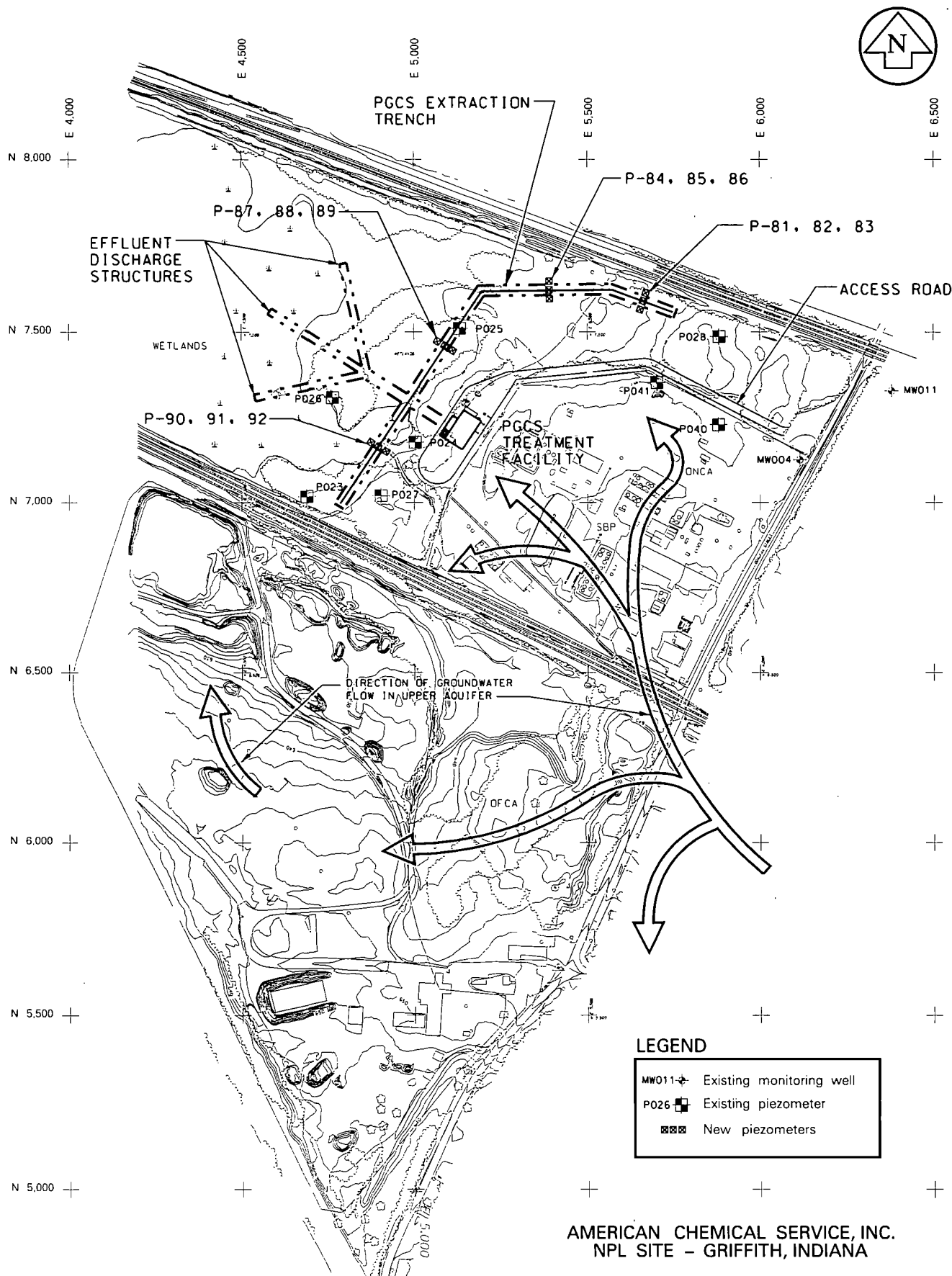
- An extraction trench to cutoff groundwater flow in the upper aquifer along the northwestern perimeter of the site
- A treatment system and an associated building and access road
- A treated groundwater conveyance line and wetlands discharges structures.

Figure 1-1 shows the approximate location of the PGCS components.

## **1.5 SCOPE OF THE BARRIER WALL AND ASSOCIATED GROUNDWATER EXTRACTION SYSTEM**

The barrier wall and associated groundwater extraction system were designed to accomplish or facilitate many of the components of the ROD remedy. They were implemented on an expedited schedule for the following reasons:

- The perimeter groundwater extraction trench was implemented on an expedited schedule and, once operational, it increased the potential for contamination to migrate from the waste areas toward the trench (i.e., towards the site boundary). Consequently, it was essential to have the barrier wall in place before or shortly after the trench was operational.



**LEGEND**

- MW011 Existing monitoring well
- P026 Existing piezometer
- New piezometers

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**PGCS COMPONENTS**

FIGURE 1-1

- Dewatering of the waste areas is necessary for the final remedy and this effort could take a substantial amount of time to complete. In addition, there is significant uncertainty about the quantity and quality of water that needs to be extracted (to dewater these areas). By expediting the barrier wall and extraction system, the dewatering process got underway sooner and it provides the opportunity to obtain additional data regarding the water so that timely modifications can be made to the extraction and treatment system, if needed, to accommodate the dewatering water.

The BWES includes the following components:

- A subsurface barrier wall
- A groundwater extraction system (consisting of nine separate extraction trenches) and conveyance piping to deliver the groundwater to the PGCS treatment system.

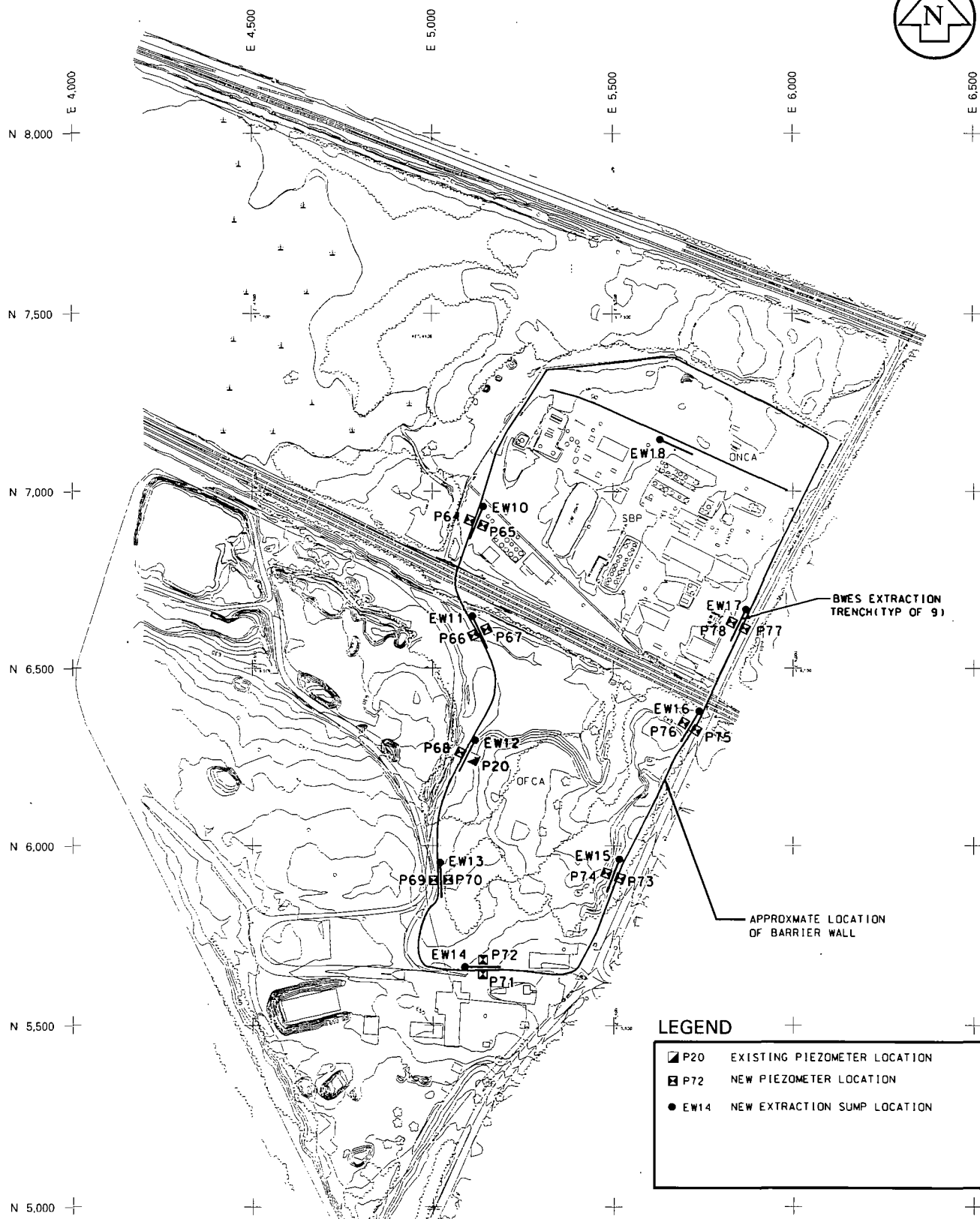
Figure 1-2 shows the approximate location of the BWES components.

## **1.6 OVERVIEW OF EXTRACTION AND TREATMENT REQUIREMENTS**

Of the facilities listed above, only the extraction and treatment systems will require ongoing operation and maintenance activities. Therefore, the barrier wall is not specifically discussed in this document. The following text presents an overview of the general extraction requirements, expected groundwater quality, and treatment requirements.

### **1.6.1. Extraction Requirements**

Since the objective of the PGCS extraction trench is to achieve hydraulic containment of groundwater along the northwestern boundary of the site, the extraction system needs to remove enough groundwater to redirect groundwater flow from its normal path towards the trench. Based on limited modeling of groundwater flow and precipitation in the area, it is estimated that a drawdown between 2 to 4 feet at the trench should be sufficient to achieve this goal. The pumping rate required to maintain this drawdown will change



NOTE:  
EW14 MAY NOT BE INSTALLED DUE TO  
CONSTRUCTION DIFFICULTIES

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## BWES COMPONENTS

FIGURE 1-2

over time until steady-state conditions are reached. It is estimated that a pumping rate of approximately 43 gpm will be required initially, but it will gradually decrease to about 15 gpm within a year.

The objective of the BWES extraction system is to dewater the area within the barrier wall. Consequently, these extraction trenches were designed to achieve complete drawdown of the water table. As with the PGCS extraction system, limited modeling was used to estimate the pumping rate from the BWES extraction trenches. Based on this modeling, the trenches are expected to yield a combined flow of 19 gpm initially, but as the area becomes dewatered, the flow is expected to decrease to about 9 gpm. If the site is capped, the flow may decrease to essentially nothing. The actual flow rate that is able to be pumped from each trench will vary depending on the type of soil and amount of debris in the surrounding area. It is expected that some trenches will continuously yield water, while others will pump dry, recover, and pump again. Obviously, the desire is to pump as much water as possible from the trenches so as to dewater the area within the barrier wall as soon as possible. However, some of the extraction pumps may need to be throttled back to avoid overloading the treatment system either hydraulically or in terms of contaminant concentration. This is important to recognize because historical data have shown that some areas of the site have very high concentrations of contamination, including free product. If trenches near these areas extract a lot of fluid, the treatment system will easily be overloaded. *The operators should be aware that the treatment system may need to be expanded if water from within the barrier wall is much more contaminated than that presented in the following section.*

### 1.6.2. Expected Groundwater Characteristics

The characteristics of the groundwater from each of the areas were estimated using samples from groundwater monitoring wells and Geoprobes. The estimated characteristics are based on the average value of samples from each area. The information collected during the RI sampling program was supplemented with results of the sampling and analysis that was performed in June 1995 as part of a bench scale treatability testing program. The June 1995 sampling activity involved collecting groundwater samples from an existing pump test well and collecting Geoprobe groundwater samples from the SBP and OFCA. The estimated characteristics of the groundwater from each area are presented in Table 1-1.

TABLE 1-1

## GROUNDWATER CHARACTERISTICS

Constituents	Units	PGCS(a)	ONCA(b)	OFCA(c,g)	SBP(d,g)	50/50 SBP/OFCA	50/50 SBP/OFCA
						Unsettled(e,g)	Settled(f),g
		March 1995	March 1995	March 1995	March 1995	June 1995	June 1995
Water Quality							
pH	Std Unit	6.7	6.7	6.45	6.30	6.32	5.81
Dissolved oxygen	mg/l	6.5	6.5	7.4	6.1		
Temperature	degree C	11.4	11.4	14.5	10.83		
Specific conductance	µmHos/cm	965	965	4,360	1,250		
Hardness, total	mg/l-CaCO3	670	670	1,366	688		
Residue, diss (TDS)	mg/l	853	853	6,410	1,328		
Residue, susp (TSS)	mg/l	125	125	967	25,367	12,400	391
Alkalinity, total	mg/l-CaCO3	455	455	1,913	473		
BOD	mg/l	16	16	36,533	2,420	8,370	14,700
COD	mg/l	111	111	139,567	4,090	79,500	26,000
Carbon (TOC)	mg/l	28	28	94,950	1,237		
Oil and grease (e)	mg/l	1.0	1.0	101,683	784	30,200	74

- (a) For organics, individual values from GWMW03 and GWMW14 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (b) For organics, individual values from GWMW04 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (c) OFCA – Average value from three geoprobe samples.
- (d) SBP – Average value from three geoprobe samples.
- (e) Sample consisted of a 50:50 mixture from OFCA and SBP areas. Samples collected by geoprobe.
- (f) Sample consisted of the aqueous phase of a 50:50 mixture from OFCA and SBP areas that was settled for 24 hours. Samples collected by geoprobe.
- (g) Geoprobe samples of 50/50 mixture collected on a different date than geoprobe samples comprising OFCA and SBP.

TABLE 1-1

GROUNDWATER CHARACTERISTICS  
(CONTINUED)

Constituents	Units	PGCS(a)	ONCA(b)	OFCA(c)	SBP(d)	50/50 SBP/OFCA	50/50 SBP/OFCA
						Unsettled(e)	Settled(f)
		March 1995	March 1995	March 1995	March 1995	June 1995	June 1995
Anions							
Chloride	mg/l	28	28	996	146		
Nitrogen, TKN	mg/l as N	9.2	9.2	234	27.07		
Phosphorus, total	mg/l as P	0.1	0.1	1.00	2.22		
Sulfate	mg/l	268	268	336	110		
Cations							
Antimony	mg/l	0.002	0.002	0.094	0.014		
Arsenic	mg/l	0.025	0.011	0.026	0.018	0.046	0.028
Cadmium	mg/l	0.010	0.010	0.61	0.06	0.96	0.543
Calcium	mg/l	188	188	274	138		
Chromium, total	mg/l	0.010	0.010	1.19	0.037	2.23	0.05
Copper	mg/l	0.020	0.020	0.26	0.24	5.61	0.27
Iron	mg/l	15.0	15.0	1,527	246	489	386
Lead	mg/l	0.007	0.007	2.43	0.176	9.61	0.105

- (a) For organics, individual values from GWMW03 and GWMW14 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (b) For organics, individual values from GWMW04 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (c) OFCA – Average value from three geoprobe samples.
- (d) SBP – Average value from three geoprobe samples.
- (e) Sample consisted of a 50:50 mixture from OFCA and SBP areas. Samples collected by geoprobe.
- (f) Sample consisted of the aqueous phase of a 50:50 mixture from OFCA and SBP areas that was settled for 24 hours. Samples collected by geoprobe.
- (g) Geoprobe samples of 50/50 mixture collected on a different date than geoprobe samples comprising OFCA and SBP.



TABLE 1-1

GROUNDWATER CHARACTERISTICS  
(CONTINUED)

Constituents	Units	PGCS(a)	ONCA(b)	OFCA(c)	SBP(d)	50/50 SBP/OFCA	50/50 SBP/OFCA
						Unsettled(e)	Settled(f)
		March 1995	March 1995	March 1995	March 1995	June 1995	June 1995
Cations (continued)							
Magnesium	mg/l	35	35	67.7	63.7		
Manganese	mg/l	0.960	2.380	NA	NA		
Mercury	mg/l	0.000	0.000	0.0025	0.0026		
Nickel	mg/l	0.020	0.020	0.54	0.097	2.09	0.78
Potassium	mg/l	6.2	6.2	31.01	11.43		
Selenium	mg/l	0.002	0.002	0.002	0.003		
Sodium	mg/l	NA	NA	604.8	38.8		
Thallium	mg/l	0.001	0.002	0.002	0.002		
Zinc	mg/l	0.063	0.063	164	1.39	33.1	19.0
Organics							
Acetone	µg/l	30	10	7,700	7,700	1,710,000	241,000
Benzene	µg/l	9,250	320	96,000	9,350	9,640,000	7,150
bis(2-Chloroethyl)ether	µg/l	50	10	340	803		

- ((a)) For organics, individual values from GWMW03 and GWMW14 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- ((b)) For organics, individual values from GWMW04 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- ((c)) OFCA – Average value from three geoprobe samples.
- ((d)) SBP – Average value from three geoprobe samples.
- ((e)) Sample consisted of a 50:50 mixture from OFCA and SBP areas. Samples collected by geoprobe.
- ((f)) Sample consisted of the aqueous phase of a 50:50 mixture from OFCA and SBP areas that was settled for 24 hours. Samples collected by geoprobe.
- ((g)) Geoprobe samples of 50/50 mixture collected on a different date than geoprobe samples comprising OFCA and SBP.

TABLE 1-1

GROUNDWATER CHARACTERISTICS  
(CONTINUED)

Constituents	Units	PGCS(a)	ONCA(b)	OFCA(c)	SBP(d)	50/50 SBP/OFCA	50/50 SBP/OFCA
						Unsettled(e)	Settled(f)
		March 1995	March 1995	March 1995	March 1995	June 1995	June 1995
Organics (continued)							
bis(2-Ethylhexyl)phthalate	µg/l	10	10	11,037	2,213	320,000	120
2-Butanone	µg/l	10	10	15,000	15,000	974,000	272,000
Butyl benzyl phthalate	µg/l	10	10	10	40	27,000	10
Chloroethane	µg/l	750	700	3,100	3,100	1	230
Chloromethane	µg/l	2.5	2.5	2	2	<0.028	1,940
4-Chloro-3-methylphenol	µg/l	10	10	10	10		
1,2-Dichlorobenzene	µg/l	20	3	1	1	569,000	10
Diethyl phthalate	µg/l	10	10	10	97	<25,000	40
2,4-Dimethylphenol	µg/l	10	15	3,870	267		
Dimethyl phthalate	µg/l	10	10	267	10	<25,000	380
Di-n-butyl phthalate	µg/l	10	10	10	97	65,000	10
Ethylbenzene	µg/l	250	3	188,700	78,467	6,200,000	664
Isophorone	µg/l	10	10	20,833	740	77,000	10

- (a) For organics, individual values from GWMW03 and GWMW14 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (b) For organics, individual values from GWMW04 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (c) OFCA – Average value from three geoprobe samples.
- (d) SBP – Average value from three geoprobe samples.
- (e) Sample consisted of a 50:50 mixture from OFCA and SBP areas. Samples collected by geoprobe.
- (f) Sample consisted of the aqueous phase of a 50:50 mixture from OFCA and SBP areas that was settled for 24 hours. Samples collected by geoprobe.
- (g) Geoprobe samples of 50:50 mixture collected on a different date than geoprobe samples comprising OFCA and SBP.

TABLE 1-1

GROUNDWATER CHARACTERISTICS  
(CONTINUED)

Constituents	Units	PGCS(a)	ONCA(b)	OFCA(c)	SBP(d)	50/50 SBP/OFCA	50/50 SBP/OFCA
						Unsettled(e)	Settled(f)
		March 1995	March 1995	March 1995	March 1995	June 1995	June 1995
<b>Organics (continued)</b>							
Methylene Chloride	µg/l	50	50	56,668	6,002	936,000	22,000
4-Methyl-2-pentanone	µg/l	10	40	14,000	14,000	2,900,000	29,600
4-Methylphenol	µg/l	10	10	560	560		
Naphthalene	µg/l	2	10	21,740	3,543	2,410,000	38
Phenol	µg/l	10	10	16,670	417		
Tetrachloroethene	µg/l	1.5	10	25,667	3,267	35,200,000	2,450
Tetrahydrofuran	µg/l	10	4,000	10	10		
Toluene	µg/l	300	300	27,064,000	336,000	31,400,000	22,600
1,1,1-Trichloroethane	µg/l					14,600,000	16,500
Trichloroethene	µg/l	10	1.5	23,067	4,667	7,650,000	3,670
Trichlorofluoromethane	µg/l	3	3	1	1	128,000	34
Vinyl chloride	µg/l	120	120	1	1	25,800	80
Xylenes, total	µg/l	5	5	1,011,000	395,000	35,000,000	1,400

- (a) For organics, individual values from GWMW03 and GWMW14 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (b) For organics, individual values from GWMW04 were averaged with the average values from the pump test. For water quality parameters, metals and ions values are from pump test.
- (c) OFCA – Average value from three geoprobe samples.
- (d) SBP – Average value from three geoprobe samples.
- (e) Sample consisted of a 50:50 mixture from OFCA and SBP areas. Samples collected by geoprobe.
- (f) Sample consisted of the aqueous phase of a 50:50 mixture from OFCA and SBP areas that was settled for 24 hours. Samples collected by geoprobe.
- (g) Geoprobe samples of 50/50 mixture collected on a different date than geoprobe samples comprising OFCA and SBP.

The columns labeled PGCS and ONCA are believed to be representative of the groundwater that will be extracted by the PGCS trench. The columns labeled OFCA and SBP are believed to be generally representative of the groundwater present in the waste areas which will be encompassed by the barrier wall. However, the characteristics listed under the OFCA and SBP are not expected to be representative of the groundwater that will be extracted by the BWES trenches because these trenches will not be placed directly in the waste areas. This issue is discussed in more detail in Section 1.6.3.2.

A comparison of the analytical data clearly indicates that the groundwater to be collected in the PGCS trench will have much lower levels of contamination than the groundwater from the waste areas. The samples from the waste areas contained much higher levels of suspended solids, organics, iron, and zinc to name a few constituents. The samples collected from the waste areas also had substantial quantities of non-aqueous phase liquids (i.e., free product or floating oil). *With the significant difference in groundwater characteristics, it is important for the operators to closely monitor and control the amount of groundwater that is removed from the waste areas and sent to the treatment plant.*

### **1.6.3. Treatment Requirements**

**1.6.3.1. Treatment System Design Flow.** Since both the PGCS and the BWES have high flows for a short initial period and then lower flows once steady-state conditions are reached, it was essential to develop a schedule for staggering the activities such that the most appropriate treatment system could be designed to meet the project's needs. This approach avoided the need to design and construct a treatment system to accommodate short duration or limited flows. A schedule for staggering the startup and operation of the major water-producing activities and the resulting estimated flows to the treatment system are presented in Table 1-2. The schedule is based on the following strategy:

Stage 1: Startup the PGCS (the extraction trench) at an initial flowrate of approximately 40 to 45 gallons per minute (gpm).

**TABLE 1-2****ESTIMATED FLOWS AND SCHEDULING TO TREATMENT SYSTEM**

Stage	Cumulative Operating Time	Flowrate		
		PGCS Trench (gpm)	BWES Trenches <sup>(a)</sup> (gpm)	Total (gpm)
1	startup	43	0	43
2	30 days	26	9	35
3	3 months	20	19	39
4	1 years	15	19	34
5	>7 years	15	9	24

(a) Actual flowrate from the BWES will depend on the quality of the water extracted from within the barrier wall and the reserve capacity of the PGCS treatment system.

- Stage 2: Startup the BWES extraction trenches after the PGCS extraction trench has been in operation for at least one month and the high initial flowrate has tapered off. Sample and analyze water from the extraction trenches within the barrier wall. Based on the contaminant concentrations in the water from each trench and the reserve capacity of the PGCS treatment system, start pumping from selected extraction trenches so as not to exceed the treatment capacity of the PGCS treatment system. The expected initial pumping rate is 9 gpm which is the minimum acceptable flowrate from within the barrier wall. (The minimum flowrate is the extraction rate required to remove water that infiltrates from precipitation so that the water level within the barrier wall does not increase and over top of the wall.)
- Stage 3: As the flow from the PGCS extraction system continues to decrease between the first and third months of operation, gradually increase the flow from the BWES trenches to 19 gpm (which is the estimated flowrate required to dewater the area within the barrier wall over a seven year period). *This can only be accomplished if the contaminant concentrations in the water from the BWES trenches are not too high for the treatment process to effectively treat to the discharge standards.* If the contaminant concentrations in the water from the PGCS extraction trench or from the BWES are higher than expected, it will be necessary to evaluate the need to increase the treatment capacity at the site by either expanding the treatment system or adding a second treatment system to handle the excess contaminant loading from the waste areas separately.
- Stage 4: As the flow from the PGCS extraction trench reaches steady-state, the flow will decrease to approximately 15 gpm. The flow from within the barrier wall is expected to remain at 19 gpm, therefore, a total flow of 34 gpm is expected to be pumped to the treatment system between the first and seventh years of operation.
- Stage 5: After 7 years of operation, it is anticipated that the PGCS extraction trench will still be pumping at 15 gpm, the waste areas will be dewatered, and flow from dewatering trenches within the barrier wall will drop to the maintenance

flow of approximately 9 gpm. The total long-term combined flow to the treatment plant is estimated to be 24 gpm.

Based on the estimated flows presented in Table 1-2, the treatment system was sized for a maximum hydraulic capacity of 60 gpm. A design hydraulic flow rate of 60 gpm provides more than enough capacity to treat the flows expected during startup of the PGCS system (safety factor of 1.4). This design flow also provides capacity to take small flows from other sources of water (such as construction dewatering) generated as part of the remedial action at the site. The long-term flow to the system is estimated to be 24 gpm (Stage 5) based on steady-state pumping from the perimeter extraction trench and maintenance flows from within the barrier wall. A flow rate of 20 gpm was therefore selected as the design minimum flow rate, and the flexibility to turn-down the treatment system to handle this flow was incorporated into the initial design. More detailed information on the hydraulic capacity of each unit process is provided later in this document.

**1.6.3.2. Estimated Influent Characteristics.** To design the treatment system, an influent profile was developed for the initial and long-term flow conditions (Stages 1 and 5) shown previously in Table 1-2. As expected, the high concentrations of contaminants in the SBP and OFCA significantly impact the quality of the influent in the long-term flow condition. There is, however, substantial uncertainty about whether or not the water quality data for these two areas are representative of what will actually be extracted from the planned dewatering system. The uncertainty revolves around the following concerns:

- The data used to characterize groundwater from these two waste areas are from samples collected using the Geoprobe method. Samples collected using properly installed and developed dewatering trenches will likely have lower levels of solids, non-aqueous phase liquids, and other contaminants.
- The Geoprobe samples were taken in the more contaminated portions of the SBP and OFCA. The BWES trenches will be placed in less contaminated areas, therefore reducing the levels of contamination in the extracted groundwater.

- Given the heterogeneous nature of the materials disposed in the SBP and the OFCA, it is very difficult to obtain a representative sample.

Because of the uncertainty associated with the quality of groundwater from the SBP and OFCA, the following decisions were made during the treatment system design:

- At a minimum, provide a phase separator for pretreatment of groundwater from the BWES trenches:
- When sizing the main treatment components, assume that the groundwater extracted from the BWES trenches will naturally have "lower" levels of contaminants than the available data indicate. This is likely to be the case because the extracted groundwater will be a mixture of highly contaminated groundwater (represented by Geoprobe data) and groundwater from less contaminated areas. If this does not prove to be the case, then additional pretreatment facilities will be installed to reduce the levels in these two streams before blending with the PGCS stream. The "lower" levels of contaminants for the BWES stream were estimated using the data from the settled sample in Table 1-1 and applying a 95 percent reduction for each constituent. The data from the settled sample is representative of the effluent from a phase separator and the 95 percent reduction should be representative of the water quality after mixing with groundwater from less contaminated areas and after passing through a pretreatment process (if necessary).
- Provide extra space to allow for the additional pretreatment facilities. The determination as to the need for the additional pretreatment facilities will be made after data are collected on the actual water extracted from the BWES trenches.

This approach offered the best potential for a flexible, and if necessary, expandable groundwater treatment system while avoiding the possibility of significantly overdesigning the facilities. By providing some capacity to handle the dewatering water, it affords the opportunity to startup the dewatering systems and collect data to characterize the actual water from within the barrier wall. *If the contaminant levels are as high as the Geoprobe data indicate, flow from the dewatering systems will need to be*



*minimized while the additional necessary pretreatment facilities are installed.* On the other hand, if the contaminant levels are much lower, additional treatment facilities may not be needed, and it may be possible to pump the dewatering systems at a higher flowrate.

Using the above assumptions, influent profiles were developed and are shown in Table 1-3 for the expected system startup and the Stage 5 (long-term) flow condition. The organic removal process was designed based on flowrate and the total contaminant loading measured as the sum of the individual organic concentrations. The total organic loadings for startup and long-term operation are estimated to be 5.7 lbs per day and 5.1 lbs per day, respectively.

**1.6.3.3. Effluent Quality Criteria.** In accordance with the ROD, effluent from the treatment system is to be discharged to the adjacent wetlands. Although a discharge permit is not required, the substantive requirements of a permit, such as effluent standards, need to be met. For discharges to the wetlands at the ACS Site, IDEM has issued the effluent limits presented in Table 1-4. In addition to the requirements listed in Table 1-4, the following conditions must be satisfied:

- The discharge shall not cause excessive foam in the receiving waters/areas. The discharge shall be essentially free of floating and settleable solids.
- The discharge shall not contain oil or other substances in amounts sufficient to create a visible film or sheen on the receiving waters/areas.
- The discharge shall be free of substances that are in amounts sufficient to be unsightly or deleterious or which produce color, odor, or other conditions in such a degree as to create a nuisance.
- The discharge shall not contain any substance in any amount sufficient to be acutely toxic to, or to otherwise severely injure or kill aquatic life, other animals, plants, or humans.

**TABLE 1-3**  
**DESIGN INFLUENT CONCENTRATIONS**

Constituents	Units	BWES Groundwater(a)	Combined Groundwaters	
			Design Condition(b)	Long-Term Condition(c)
Flow	gpm	13	55	20
<b>Water Quality</b>				
pH	Std Unit	6.4	6.6	6.5
Dissolved oxygen	mg/l	0	0	0
Temperature	degree C	12	16	19
Specific conductance	µmhos/cm	3,164	1,470	1,819
Hardness, total	mg/l-CaCO <sub>3</sub>	1,105	772	842
Residue, diss (TDS)	mg/l	4,455	651	512
Residue, susp (TSS)	mg/l	1,000	152	171
Alkalinity, total	mg/l-CaCO <sub>3</sub>	1,359	667	813
BOD	mg/l	23,413	189	310
COD	mg/l	87,460	416	627
Carbon (TOC)	mg/l	58,907	104	157
Oil and grease	mg/l	30,000	1.9	2.6
<b>Anions</b>				
Chloride	mg/l	670	258	417
Nitrogen, TKN	mg/l as N	155	42	66
Phosphorus, total	mg/l as P	1.5	0.5	0.7
Sulfate	mg/l	250	263	261
<b>Cations</b>				
Antimony	mg/l	0.090	0.023	0.037
Arsenic	mg/l	0.030	0.019	0.027
Cadmium	mg/l	0.540	0.135	0.222
Calcium	mg/l	220	195	201
Chromium, total	mg/l	0.750	0.019	0.026
Copper	mg/l	0.300	0.086	0.132
Iron	mg/l	1,034	106	169
Lead	mg/l	1.500	0.029	0.044
Magnesium	mg/l	70	43	49
Manganese	mg/l	NA	NA	NA

- (a) High-strength influent to phase separation. Flowrate of 13 gpm includes on 8 gpm from OFCA and 5 gpm from SBP.
- (b) Design Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 55 gpm includes 12 gpm from PGCS, 30 gpm from ONCA, 8 gpm from OFCA and 5 gpm from SBP.
- (c) Long-Term Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 20 gpm includes 12 gpm from PGCS, 5 gpm from OFCA and 3 gpm from SBP.

NA Not available

**TABLE 1-3**  
**DESIGN INFLUENT CONCENTRATIONS**  
**(CONTINUED)**

Constituents	Units	BWES Groundwater <sup>(a)</sup>	Combined Groundwaters	
			Design Condition <sup>(b)</sup>	Long-Term Condition <sup>(c)</sup>
Cations (continued)				
Mercury	mg/l	0.0025	0.0007	0.0011
Nickel	mg/l	0.800	0.204	0.332
Potassium	mg/l	25	11	14
Selenium	mg/l	0.002	0.002	0.002
Sodium	mg/l			
Thallium	mg/l	0.0020	0.0019	0.0014
Zinc	mg/l	100	4.8	8.0
Organics				
Acetone	µg/l	125,000	1,489	2,518
Benzene	µg/l	63,000	2,311	5,750
bis(2-Chloroethyl)ether	µg/l	500	22.3	40.0
bis(2-Ethylhexyl)phthalate	µg/l	8,000	13.5	16.0
2-Butanone	µg/l	150,000	1,780	3,006
Butyl benzyl phthalate	µg/l	20.0	7.8	6.2
Chloroethane	µg/l	3,100	548	455
Chloromethane	µg/l	2,000	25.5	41.5
4-Chloro-3-methylphenol	µg/l	10.0	7.8	6.2
1,2-Dichlorobenzene	µg/l	10,000	124	212
1,1-Dichloroethane	µg/l	25,000	448	620
1,2-Dichloroethane	µg/l	66,000	78.5	126
1,1-Dichloroethene	µg/l	80.0	2.5	2.8
1,2-Dichloroethene-cis	µg/l	75,000	1,317	2,010
1,2-Dichloroethene-trans	µg/l	20.0	27.0	21.4
1,2-Dichloropropane	µg/l	300	4.7	6.9
Diethyl phthalate	µg/l	40.0	8.1	6.8
2,4-Dimethylphenol	µg/l	2,500	34.0	46.0
Dimethyl phthalate	µg/l	400	12.4	14.0
Di-n-butyl phthalate	µg/l	100	8.8	8.0
Ethylbenzene	µg/l	146,000	174	350

- (a) High-strength influent to phase separation. Flowrate of 13 gpm includes on 8 gpm from OFCA and 5 gpm from SBP.
- (b) Design Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 55 gpm includes 12 gpm from PGCS, 30 gpm from ONCA, 8 gpm from OFCA and 5 gpm from SBP.
- (c) Long-Term Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 20 gpm includes 12 gpm from PGCS, 5 gpm from OFCA and 3 gpm from SBP.

NA Not available

TABLE 1-3

**DESIGN INFLUENT CONCENTRATIONS  
(CONTINUED)**

Constituents	Units	BWES Groundwater <sup>(a)</sup>	Combined Groundwaters	
			Design Condition <sup>(b)</sup>	Long-Term Condition <sup>(c)</sup>
<b>Organics (continued)</b>				
Isophorone	µg/l	13,000	7.8	6.2
Methylene Chloride	µg/l	37,000	298	470
4-Methyl-2-pentanone	µg/l	30,000	379	606
4-Methylphenol	µg/l	560	13.5	16.0
Naphthalene	µg/l	15,000	11.8	11.2
Phenol	µg/l	10,500	126	206
Tetrachloroethene	µg/l	17,000	35.3	50.9
Tetrahydrofuran	µg/l	10.0	2,184	6.2
Toluene	µg/l	16,784,000	525	680
1,1,1-Trichloroethane	µg/l	17,000	203	346
Trichloroethene	µg/l	16,000	50.3	86.0
Trichlorofluoromethane	µg/l	30.0	2.6	2.4
Vinyl chloride	µg/l	80.0	92.6	73.6
Xylenes, total	µg/l	775,000	27.5	43.0

- (a) High-strength influent to phase separation. Flowrate of 13 gpm includes on 8 gpm from OFCA and 5 gpm from SBP.
- (b) Design Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 55 gpm includes 12 gpm from PGCS, 30 gpm from ONCA, 8 gpm from OFCA and 5 gpm from SBP.
- (c) Long-Term Condition assumes contaminant levels in the OFCA and SBP will actually be 95% lower than Geoprobe data show. Flowrate of 20 gpm includes 12 gpm from PGCS, 5 gpm from OFCA and 3 gpm from SBP.

NA Not available

TABLE 1-4

## EFFLUENT LIMITATIONS FOR DISCHARGE TO WETLANDS

Constituent	Units	Effluent Limitation
<b>General Water Quality Parameters</b>		
BOD5	mg/l	30
TSS	mg/l	30
pH	s.u.	6 to 9
<b>Inorganics</b>		
Arsenic	µg/l	50
Cadmium	µg/l	4.1
Mercury	µg/l	0.02 w/MDL=0.1(a)
Selenium	µg/l	8.2
Zinc	µg/l	411
<b>Volatile Organics</b>		
Acetone	µg/l	6,800
Benzene	µg/l	5
2-Butanone	µg/l	210
1,2-Dichloroethene-cis	µg/l	70
Ethylbenzene	µg/l	34
Methylene chloride	µg/l	5
Tetrachloroethene	µg/l	5
Trichloroethene	µg/l	5
Vinyl chloride	µg/l	2
4-Methyl-2-pentanone	µg/l	15
<b>Semi-Volatile Organics</b>		
bis(2-Chloroethyl)ether	µg/l	9.6
bis(2-Ethylhexyl)phthalate	µg/l	6
Isophorone	µg/l	50
4-Methylphenol	µg/l	34
Pentachlorophenol	µg/l	1
<b>PCBs</b>		
PCBs	µg/l	0.00056 w/MDL=0.1 to 0.9(a)

- (a) Concentration shown is the effluent limitation, but analytical results showing less than the method detection limit shown will be considered as in compliance. The method detection limit for PCBs is different for each isomer.

- The discharge shall not contain any substances or combinations of substances in amounts that will cause or contribute to the growth of aquatic plants or algae to such degree as to create a nuisance, be unsightly or otherwise impair the designated use.
- There shall be no debris discharge. Debris is defined as woody material such as bark, twigs, branches, heartwood or sapwood that will not pass through a 1.0 in diameter round opening and is present in the discharge from a wet storage facility.

**1.6.3.4. Process Air Emissions Criteria.** Although no IDEM permit is required for air emissions control, the PGCS treatment facility provides adequate controls to prevent venting potentially toxic vapors into the treatment building or to the atmosphere. Specific information on the air emissions limitations and monitoring requirements are included in Volume 2 Performance Standard Verification Plans.

**1.6.3.5. Residuals Management.** The PGCS treatment facility is expected to generate three types of residuals: (1) non-aqueous phase liquids (NAPL), (2) sludge, and (3) spent carbon. Until notified otherwise by EPA or the ACS Technical Committee, all three materials should be managed as an F-listed hazardous waste.

#### NAPL

The NAPL will need to be incinerated. The operators will need to collect samples of the NAPL to be sent to a laboratory for analysis. Based on the results, an appropriate licensed disposal contractor and the associated costs can be determined.

#### Sludge

The sludge from the treatment facility will need to be analyzed to determine if it can be landfilled in a RCRA Subtitle C (hazardous waste) landfill or if it needs to be incinerated. The analytical results must be compared to the Treatment Standards in 40 CFR 268.40 Subpart D to make this determination.

### Spent Carbon

Similar to the sludge, the spent carbon needs to be sampled and analyzed to determine if it can be landfilled in a RCRA Subtitle C landfill or if it needs to be incinerated.

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## **Section 2**

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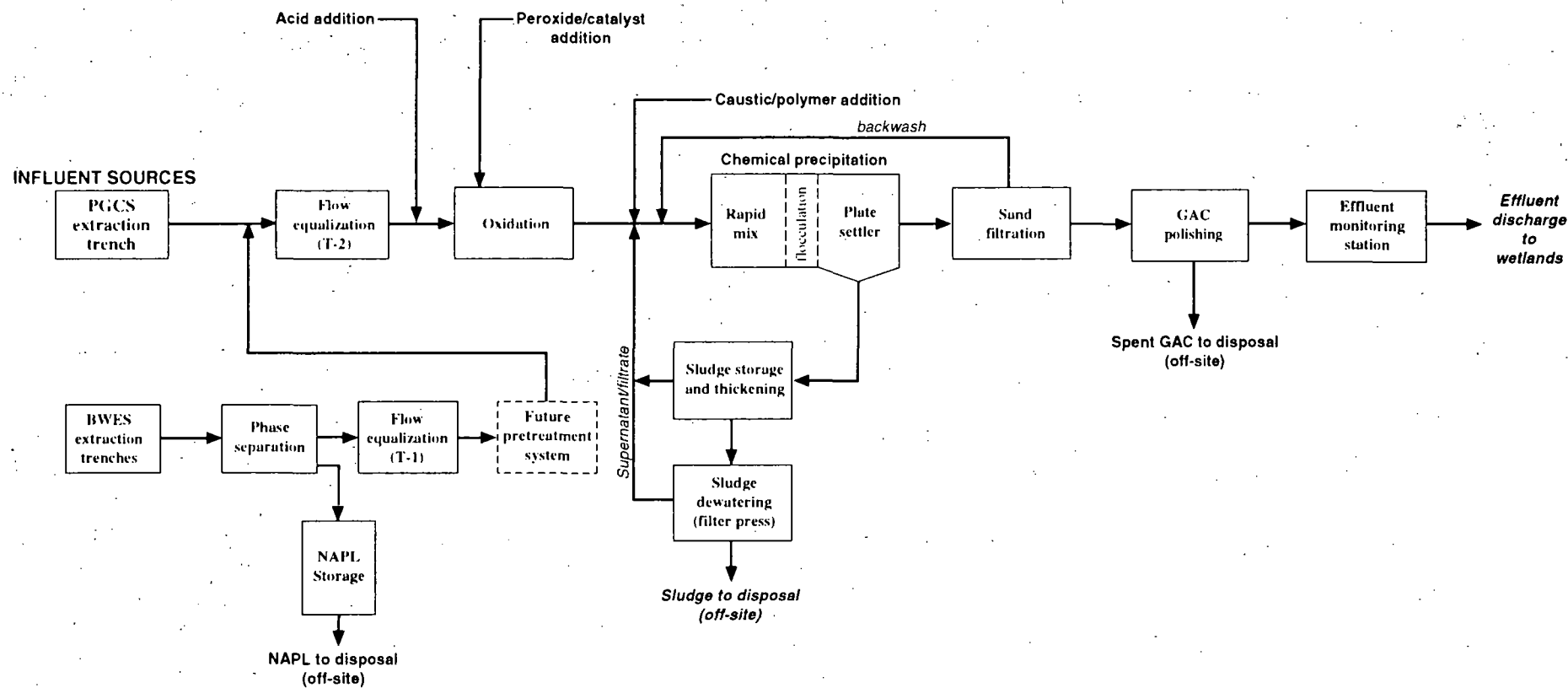
## 2.0 GENERAL DESCRIPTION OF THE FACILITIES

### 2.1 OVERVIEW

Based on the groundwater characteristics presented in Table 1-1, the types and concentrations of contaminants to be treated prior to discharge varies considerably depending on how much water is being extracted from each area. The major contaminants in the PGCS and ONCA groundwater include iron, and a limited number of aromatic and chlorinated solvents such as benzene, ethylbenzene, tetrachloroethene, trichloroethene, vinyl chloride, bis(2-chloroethyl)ether, and bis(2-ethylhexyl)phthalate that are present at low concentrations. The major contaminants in the high-strength SBP and OFCA groundwaters include TSS, COD, BOD, TOC, non-aqueous phase liquids (NAPL), iron and other metals as well as wide variety of individual volatile and semivolatile organic compounds as listed in Tables 1-1 and 1-3.

Based on an evaluation of applicable treatment processes, a multi-process treatment train was selected for implementation at the site. The selected treatment train incorporates the necessary facilities to reduce all of the constituents to the appropriate discharge levels. *Given the uncertainty regarding the levels of contaminants in the SBP and OFCA, some of the components were not installed at this time.* Once data are available on the actual water extracted from the BWES, a determination can be made regarding the need for and appropriate sizing of the components that are currently not installed.

Figure 2-1 provides a conceptual process flow diagram for the extraction and treatment facilities. As shown in the figure, groundwater from the PGCS trench should be routed directly to the main equalization tank (T-2). Groundwater from the BWES trenches, on the other hand, is expected to have high levels of organic contaminants, suspended solids and possibly NAPL. Consequently, this stream should first be routed through the phase separator to remove or at least reduce the solids and NAPL. Effluent from the phase separator flows by gravity to the pretreatment equalization tank (T-1). As shown in the figure, it is likely that additional pretreatment facilities will be necessary to reduce the high-strength water from the BWES trenches so as to avoid overloading the main treatment processes. Therefore, tank T-1 will serve to equalize the influent flow to the additional pretreatment facilities if they are installed in the future. At this time, however, tank T-1 merely provides additional storage capacity. As T-1 fills, the water is pumped



to T-2 where it is blended with the groundwater from the PGCS trench to produce a fairly consistent influent for the main treatment processes.

The main process train for treating the groundwater incorporates several components as follows:

- Ultraviolet light/hydrogen peroxide oxidation to destroy dissolved organics
- Chemical precipitation to remove dissolved iron, other metals, and solids
- Sand filtration to provide additional removal of solids
- Carbon adsorption to provide effluent polishing of dissolved organics.

In addition to the above, facilities for thickening and dewatering the sludge are included in the plant.

The treatment system installed at this time contains all of the equipment necessary to treat the maximum flow rate (60 gpm) with the organic, metals and suspended solids concentrations listed for the "design condition" combined influent shown in Table 1-3. The facility also includes phase separation and oil storage tanks capable of handling a flowrate up to 13 gpm from the BWES trenches. Additional space and piping to facilitate system retrofit and expansion in the future are provided. Space is also provided for an additional phase separator for treatment of high-strength influent should additional phase separation capacity be needed. The system is intended to operate continuously 24 hours per day (except for planned shutdowns for maintenance) at influent flowrates between 20 and 60 gpm. At flowrates below 20 gpm, water will be accumulated until a sufficient volume is collected to process at a flowrate of 20 gpm (i.e., semi-batch treatment mode).

Table 2-2 (located at the end of this section) provides a list of all major equipment, their identification numbers, and pertinent design information.

## **2.2 EXTRACTION FACILITIES**

### **2.2.1. PGCS Extraction Facilities**

The PGCS extraction system consists of a 14-foot deep by 1300-foot long extraction trench with three extraction sumps. The extraction trench was constructed using the "single-pass" trencher method and, as a result, it actually consists of three separate trench legs that overlap slightly. Each sump is located at the northern most end of one of the trench legs. An electric submersible pump is located in each sump and all three pumps discharge into a common 2-inch diameter HDPE pipeline that conveys water to the treatment building. All the discharge pipes are buried for frost protection, so pitless adapters were installed on the sump casings to allow for removal of the extraction pumps if needed.

Since the purpose of the PGCS extraction system is to contain contaminated groundwater before it leaves the site, the system only needs to lower the water table at the trench by about 2 to 4 feet (water level monitoring will confirm this). This should be sufficient to change the existing groundwater flow direction and control the migration of contaminated water. With this in mind, the extraction pipe in the PGCS trench was placed about 2 to 4 feet off the bottom of the trench.

As stated in Section 1.0, the amount of groundwater that needs to be extracted to maintain the desired drawdown will vary with time. Since the pumps are constant speed, a valve was installed on the discharge line of each pump to allow throttling back of the flow. Groundwater extracted from the PGCS trench should be routed directly to tank T-2 by opening and closing the respective valves on the influent header located inside the treatment building.

### **2.2.2. BWES Extraction Facilities**

The BWES extraction system consists of nine extraction trenches, each 100 feet long and ranging in depth from 16 feet to 25 feet. [At the time this manual was completed, only eight of the nine trenches were installed. Therefore, trench EW-14 may not be installed.] Each trench has a sump at one end that is completed with an inground vault. A pneumatic pump is installed in each sump and all pumps discharge into a common 2-inch HDPE pipe that conveys the water to the treatment building. Although all pipes are buried for frost protection, the pump discharge pipe runs through the vault so it can easily be disconnected to allow removal of the pump if necessary.

The purpose of the BWES extraction system is to lower the water table within the barrier wall so that it is below the level of the water table outside the barrier wall (i.e., create an inward gradient). This is to make sure that if there is an area of the wall where water can pass through, the tendency will be for clean water to come in and not for contaminated water to migrate out. In addition to creating an inward gradient, the BWES extraction system is also intended to begin the process of completely dewatering the area within the barrier wall. Ultimately, the goal is to remove all groundwater in the waste areas down to the clay layer. Consequently, the extraction pipe in each of the BWES trenches is placed at the bottom of the trench.

As the BWES trenches dewater the area within the barrier wall, the amount of groundwater being extracted will gradually decrease. Initially, however, the combined flow from all the trenches may be greater than the treatment system can handle. Consequently, the extraction rate from some of the pumps may need to be reduced by reducing the air pressure to the pump and/or raising the pump level. Pneumatic pumps were selected because they are well suited to the intermittent low flow situations we expect to experience with the BWES trenches. Groundwater extracted from the BWES trenches should always be routed through the phase separator since there is a high potential for NAPL in these areas. Even if NAPL is not present in the extracted groundwater initially, it may migrate to one of the trenches as the area is dewatered. The cost to run the BWES groundwater through the separator is insignificant compared to the cost to deal with the effects of allowing NAPL to run through the main treatment system.

## **2.3 PRETREATMENT FACILITIES**

The pretreatment facilities currently installed include a phase separator, pretreatment equalization tank, NAPL storage tank, and a sludge transfer pump.

### **2.3.1. Phase Separator**

Separation of undesirable NAPL and solids is accomplished using a gravity separator with coalescing plates to aid in phase separation. The NAPL material floats to the top of the tank and flows over an adjustable weir to a NAPL storage tank located below the separation unit. Solids that settle out in the separator are pumped to a sludge storage tank for thickening prior to either off-site disposal or dewatering in a filter press.

### **2.3.2. NAPL Storage Tank**

NAPL separated from the extracted groundwater is stored in the 6,500-gallon NAPL storage tank. When the NAPL reaches the high level mark, a "Tank Full" alarm is triggered to let the operator know it is time to hire a contract hauler to remove the NAPL and transport it to an approved off-site facility. The tank is equipped with a quick connect fitting which penetrates the building wall over the truck pad on the western side. The tank is also equipped with a visual indication of the tank level so the operators know approximately how much storage volume is available before the tank is full.

### **2.3.3. Sludge Transfer Pump**

Solids that settle out in the phase separator are pumped periodically to the sludge storage/thickening tank. The phase separator is provided with an air diaphragm pump for transferring the sludge collected in the hopper. The pump can be operated manually or automatically based on a timer control.

### **2.3.4. Pretreatment Equalization Tank**

Effluent from the phase separator flows by gravity to the 3,000 gallon pretreatment equalization tank (T-1). The pretreatment equalization tank was installed to provide sufficient blending and equalization of the BWES streams. The detention time in the equalization tank is approximately 3 hours at a flow rate of 19 gpm. The tank is supplied with a mixer to blend the groundwater, and the tank also functions as a wetwell for the pretreatment pumps. At this time, the pumps will merely transfer the water from T-1 to the main equalization tank (T-2). If additional pretreatment units are added in the future, the pumps will serve as the influent pumps to those units.

## **2.4 MAIN TREATMENT FACILITIES**

The major components of the main treatment process include: the main equalization tank, UV oxidation system, chemical precipitation unit, sand filtration, pH adjustment tank, and the carbon adsorption vessels. The solids handling facilities are also discussed with the main treatment process. Figure 2-2 provides a detailed process flow diagram to be used as a reference for this section of the manual. Table 2-1 is an equipment list that

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## Section 1

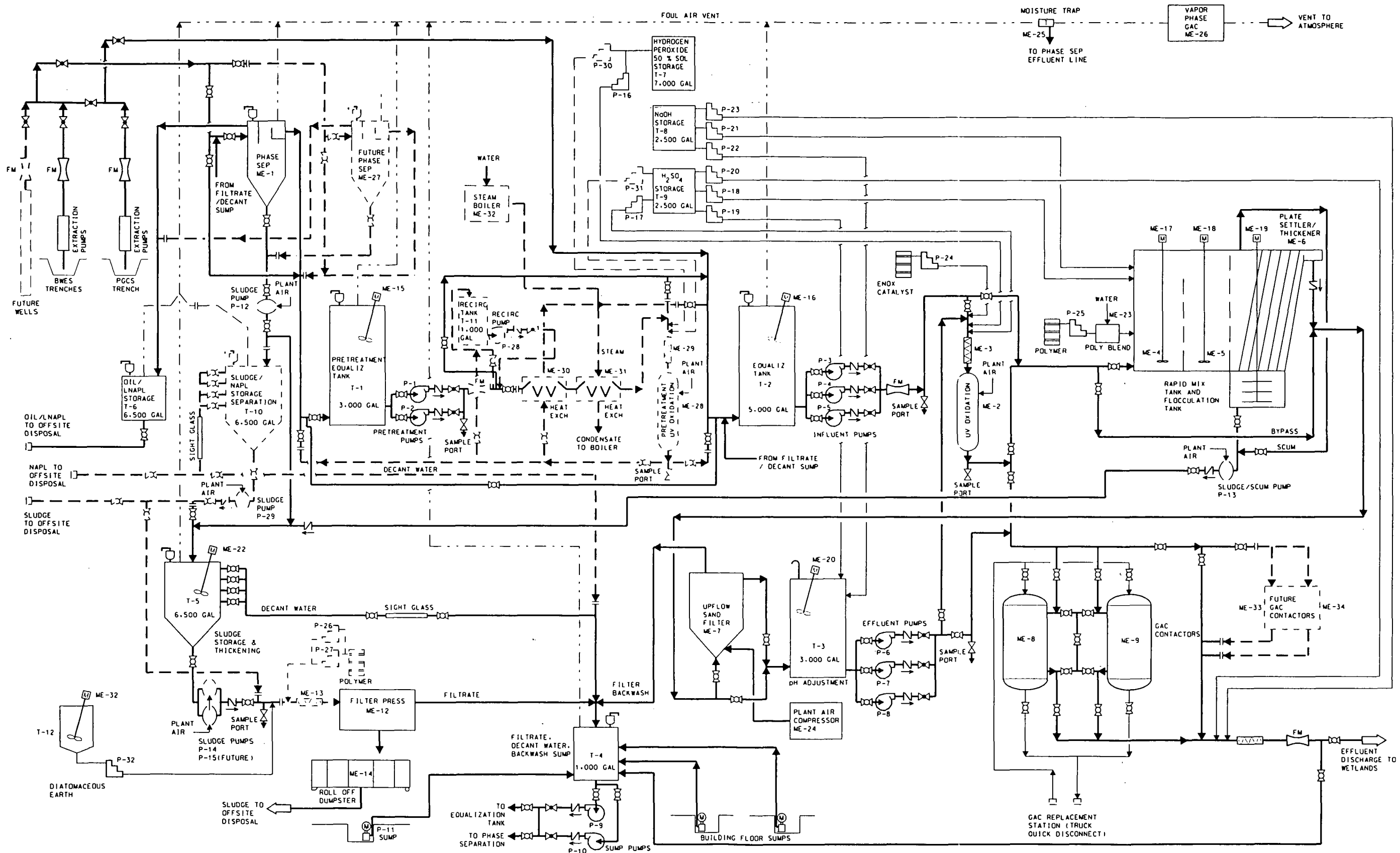
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# PROCESS FLOW DIAGRAM

FIGURE 2-2

shows all major components, their identification number, and associated design information.

#### **2.4.1. Main Equalization Tank**

To provide sufficient blending and equalization of the influent streams, 50 minutes of equalization capacity is provided in the main equalization tank (T-2) at a flow rate of 60 gpm. The equalization tank receives low-strength groundwater directly from the PGCS trench and mixes it with the pretreated high-strength BWES groundwater. The tank is supplied with a mixer to blend the groundwaters and it also functions as a wetwell for the influent feed pumps for the main treatment processes.

#### **2.4.2. UV Oxidation System**

The UV oxidation system provides destruction of the organic components in the groundwater by oxidation of the organic molecules to carbon dioxide, water, and chloride, nitrate, or sulfate ions depending on the contaminants. Halogens such as chloro- and bromo- substituents are converted to salts. The system uses hydrogen peroxide as the main source of oxidizing potential. Both high intensity UV light and reduced iron salts (ferrous sulfate) are used as catalysts. The main oxidizing species created by the process are hydroxyl radicals which are formed during the decomposition of peroxide by the two catalysts. Oxidation of the organic material and reduced iron in the influent stream is accomplished by injecting sulfuric acid and hydrogen peroxide. The water then passes through a reactor containing a high intensity ultraviolet lamp. The UV light and reduced iron in the water catalyze the decomposition of the peroxide into hydroxyl radicals which subsequently attack and destroy dissolved organic material. Ferrous sulfate (Enox) is injected as an additional source of iron, however, its use on a regular basis is unlikely because of the relatively high reduced iron content of the groundwater at the site. Some decomposition of organic material also results from the direct effect of UV light and peroxide which act as oxidizing agents, although less powerful than hydroxyl radicals. The reduced iron is also oxidized in the process, and forms an insoluble precipitate upon adjustment of the pH (using sodium hydroxide) following the reaction.

Effluent from the oxidation process flows to the chemical precipitation system for removal of iron, other metals, and suspended solids.

### **2.4.3. Chemical Precipitation Unit**

Oxidized iron, other metals such as lead, zinc, nickel, copper and chromium, and suspended solids in the effluent from the oxidation system are removed in the chemical precipitation unit. The unit consists of a rapid mix tank in which the pH is raised to the desirable level (approximately 10 s.u.); a flocculation tank in which small particles are encouraged to form larger, easier to settle particles; and a plate settler (Lamella clarifier) with an internal sludge thickener. Sulfuric acid and sodium hydroxide feed systems are provided for pH adjustments. Liquid polymer is used to aid in coagulation and flocculation of the metal precipitates and suspended solids. The polymer feed system consists of a metering pump and a Polyblend™ mixing system. Emulsion polymer (approximately 30 percent solution) is fed from a day tank (55-gallon drum) and will be diluted to approximately one percent strength by the Polyblend™ system before being fed to the rapid mix tank. Sludge from the settler/thickener unit is either manually or automatically based on a timer pumped to the sludge storage and thickening tank. Effluent from the settler flows by gravity to the sand filtration unit.

### **2.4.4. Upflow Sand Filter**

The residual suspended solids in the metals precipitation unit effluent are removed in an upflow, continuous backwash sand filter. A continuous backwash filter was selected over conventional gravity sand filters or pressure sand filters because it eliminates the need for a backwash cycle and the associated storage facilities and pumps. Operator attention requirements are reduced with a continuous backwashing system and hydraulic surges associated with backwash cycles are eliminated. Influent to the filter will flow by gravity from the Lamella clarifier. Sufficient hydraulic head exists in the filter influent to pass through the sand bed and into the pH adjustment tank (following the filter) without the need for pumping. Continuous backwashing is provided using an airlift pump, which transfers a small percentage of flow containing the filtered solids from the system. Filter backwash water flows to the filtrate/decant water and backwash sump prior to being returned to either the phase separator or the main equalization tank.

#### **2.4.5. pH Adjustment Tank**

The pH of the effluent from the chemical precipitation system and sand filter is adjusted to between 6 and 9 s.u. for final discharge. pH adjustment is accomplished in a tank equipped with a mixer, pH probe, and a controller. Sulfuric acid and sodium hydroxide feed systems are provided for pH adjustment. Acid and caustic solutions are fed from the bulk storage tanks. The pH adjustment tank also serves as a wetwell for the effluent pumps that convey treated water through the GAC contactors.

#### **2.4.6. GAC Contactors**

If the final filtered effluent contains specific chemical constituents in concentrations above the allowable discharge goals, the flow will need to be routed through GAC contactors for additional treatment. Under normal operating conditions, the use of GAC for effluent polishing is not expected. The GAC system acts as a backup to the other treatment processes should upsets, failures or unexpected problems arise with those systems. The GAC system should be used during start-up to ensure compliance with effluent limits. The GAC contactor system is a vendor supplied package consisting of two contactor units. The system has the capability to operate in either parallel or series mode depending on the particular treatment needs, but will usually operate in series. Each column has the hydraulic capacity to handle the maximum flow. Replacement of the carbon will be conducted when the adsorption capacity has been exhausted. Spent carbon will be replaced by the carbon system supplier (in conjunction with the plant operators). Carbon exhaustion is determined by effluent sampling and analysis, and by operator experience.

#### **2.4.7. Effluent Monitoring and pH Control**

An in-line magnetic flow meter is provided in the effluent discharge pipe to monitor the effluent discharge flow rate. A second pH adjustment step is provided to make sure the treated water's pH is between 6 and 9 s.u. for final discharge. pH adjustment is accomplished in-line with a mixer, pH probe, and a controller. Sulfuric acid and sodium hydroxide feed systems are provided for pH adjustment. Acid and caustic solutions are fed from the bulk storage tanks.

#### **2.4.8. Sludge Handling System**

The sludge handling system provides a means to accumulate, blend, and concentrate the sludge from the phase separator and chemical precipitation unit prior to off-site disposal. The elements of this system are: a mixed sludge storage and thickening tank, a diatomaceous earth feed system, a sludge transfer pump, and a plate and frame filter press.

Sludge from the chemical precipitation system and from the phase separator are pumped to the sludge storage tank which is equipped with a mixer for blending. Sludge is allowed to settle and thicken in the storage tank prior to dewatering. The sludge storage tank is equipped with multiple decant ports for removal of free water. The decant ports discharge to a pipeline carrying waste liquids to the filtrate/decant water and backwash sump. The decant discharge line is provided with a sight glass so that the plant operator can assess the quality of the liquid withdrawn. Thickened sludge from the storage tanks is pumped to the filter press for dewatering. Diatomaceous earth may need to be added as a filter precoat or body-feed during sludge dewatering, and facilities are provided for this purpose. Filter cake from the press drops into a roll-off dumpster and is periodically transported off site for disposal.

#### **2.4.9. Filtrate, Decant Water, Backwash Sump**

A main process sump is provided for collection of reject water from all of the unit processes, and from the floor sumps within the building containment structure. The water collected in the sump is returned to either the influent line to the phase separator or to the main treatment system equalization tank at the discretion of the plant operator.

#### **2.4.10. Area Sumps**

Two floor sumps are provided in the building containment area to collect spills and washdown water. Water collected in the floor sumps is returned to the main process sump using their respective sump pumps. A floor sump is also located beneath the roll-off dumpster to collect any drainage from the dewatered sludge and washdown water from the sludge storage pad.

## **2.5 SUPPORT FACILITIES**

The design of the treatment facility incorporates the required support systems to provide a complete and functional groundwater treatment system.

### **2.5.1. Air Collection System**

Process air is collected from treatment units that have a potential to emit foul air. Collected foul air is passed through a vapor-phase GAC bed prior to discharge to the atmosphere. The vapor-phase GAC may be eliminated based on the results of the air monitoring program, and the foul air would be discharged directly to the atmosphere. The process units connected to the air collection system include:

- Phase Separator
- NAPL Storage Tank
- Sludge Storage/Thickening Tank
- Pretreatment Equalization Tank
- Main Equalization Tank
- Filtrate, Decant Water, Backwash Sump.

The volatile organics in the influent groundwater are destroyed in the UV oxidation system, and therefore, downstream processes such as the chemical precipitation system, sand filter, pH adjustment tank, and GAC contactors can vent inside the building. The filter press is vented to the outside and the roll-off dumpster is located in a separate enclosed area which is also vented to the outside.

### **2.5.2. Compressed Air System**

Compressed air is required for operation of the BWES extraction pumps, the air diaphragm pumps, filter press, sand filter backwash, and the wiper drive for the UV oxidation system. The air compressor unit is a complete system with dual compressors, two receiving tanks, gauges, air distribution and control systems, and instrumentation. The air compressor unit has been designed to produce the required air capacity to allow simultaneous operation of the air-controlled extraction and treatment systems.

### **2.5.3. Facility Water**

Potable, fire and service water for the PGCS treatment facility are provided through a City water line which extends to the facility. At this time, the water supply line has very low water pressure. Tentative arrangements have been made to work with the ACS production facility to install a booster pump which would increase water pressure. If this is not installed, it will be necessary to install a separate pressure tank and booster pump in the treatment building.

### **2.5.4. Chemical Feed Systems**

Chemical addition is required to facilitate the several treatment processes, maintain pH in the desired range, or to enhance solids settling and separation. Chemical injection is conducted at the following process units:

- UV Oxidation System - acid, hydrogen peroxide, and Enox catalyst addition
- Chemical Precipitation Unit - acid, caustic, and polymer addition
- pH Adjustment Tank - acid and caustic addition
- Effluent Sump - acid and caustic addition
- Filter Press - polymer and diatomaceous earth addition.

The chemical addition system includes the following components:

- Sulfuric acid storage tank
- Sodium hydroxide storage tank
- Hydrogen peroxide storage tank
- Polymer blending system
- Diatomaceous earth day tank
- Chemical metering pumps
- Instrumentation and control loops.

### **2.5.5. Miscellaneous Support Systems**

In addition to the above support systems, the treatment building is supplied with other necessary systems such as electrical power; a sewage holding tank; gas supply; and heating, ventilation, and air conditioning. These are not discussed in this plan and the operators should refer to the manufacturer's manuals or the as-built drawings for more information.



**TABLE 2-1**  
**EQUIPMENT LIST**

Component	Identification Number	Parameter	Design Information
<u><i>PGCS Extraction System</i></u>			
Extraction Sumps	EW-19 through EW-21	Casing	6 to 12-inch PVC
Extraction Pumps	EP-19 through EP-21	Type Design Flow Pump Capacity	Electric submersible 15 gpm 16 gpm @ 100 ft TDH
Pitless Adapters (one per pump)	NA	Type	1-inch brass, clamp-on
Throttling Valves (one per pump)	NA	Type Size	Gate 1-inch
Conveyance Pipe	NA	Size and Material	1-inch to 2-inch HDPE
<u><i>Barrier Wall Extraction System</i></u>			
Extraction Sumps	EW-10 through EW-18	Size	12-inch PVC to 6-inch CS casing; in-ground vault completion
Extraction Pumps	PP-10 through PP-18	Type Design Flow Pump Capacity	Pneumatic pump, bottom loading, short 5 gpm @ 40 psig 10 gpm @ 40 psig
Conveyance Pipe	NA	Size and Material	1-inch to 2-inch HDPE
<u><i>Treatment System</i></u>			
Phase Separator	ME-1	Type Maximum Capacity Design Flow Material Media Surface Area	Coalescing plate 30 gpm 19 gpm Stainless steel 672 sq ft
Sludge Pump	P-12	Type Capacity	Air diaphragm 100 gpm @ 120 psig

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
Oil/NAPL Storage Tank	T-6	Capacity Material Size	5,700 gal Stainless steel 9' dia x 12' SWD
Pretreatment Equalization Tank	T-1	Capacity Retention Time Material Size	3,400 gal 3 hrs HRT @ 19 gpm Stainless steel 8' dia x 9' SWD
Mixer	ME-15	Type Motor Data	3 Blade axial flow turbine 2.0 hp, 3 ph, 60 Hz, 230/460 V AC, 1750 rpm
Pretreatment Pumps	P-1 and P-2	Type Capacity Motor Data  Intended Operation	Close-coupled, end-suction, TEFC 15 gpm @ 56 ft TDH 1 hp, 3 ph, 60 Hz, 230/460 V AC, 3450 rpm 1 on-line, 1 standby
Main Equalization Tank	T-2	Capacity Retention Time Material Size	5,700 gal 1 hr @ 60 gpm Stainless steel 9' dia x 12' SWD
Mixer	ME-16	Type Motor Data	4 Blade axial flow turbine 1.5 hp, 3 ph, 60 Hz, 230/460 V AC, 1725 rpm
Influent Pumps	P-3, P-4, and P-5	Type Capacity Motor Data  Intended Operation	Close-coupled, end-suction, TEFC 30 gpm @ 96 ft TDH 2 hp, 3 ph, 60 Hz, 230/460 V AC, 3450 rpm 2 online; 1 standby
Enox Feed Pump	P-24	Type Capacity	Solenoid-driven diaphragm 0.57 gph @ 145 psig

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
In-Line Mixer	ME-3	Size Flow Rate Pressure Drop	2-inch CPVC 27 - 60 gpm 1.1 - 5.3 psig
UV Oxidation System	ME-2	Max Flow Min Flow Removal Efficiency @ 60 gpm @ 20 gpm Lamp Material	60 gpm 10 gpm 90% COD 99% specific organics 95% COD 99.5% specific organics 30 kW Stainless steel
Poly Blend Unit	ME-23	Type Water Capacity Polymer Capacity Pressure Rating Motor Data	Continuous, in-line dilution and activation unit 16 gph 1.0 gph 100 psig 1/6 hp, 1 ph, 60 Hz, 120 VAC
Polymer Feed Pump	P-25	Type Capacity	Solenoid-driven diaphragm
Peroxide Storage Tank (Bulk 50% hydrogen peroxide)	T-7	Capacity Material Size	7,300 gal Stainless steel 10' dia x 14'-5" long, horizontal
Peroxide Feed Pump	P-16	Type Capacity	Solenoid-driven diaphragm 1.5 gph @ 145 psig
Caustic Storage Tank (Bulk 50% sodium hydroxide)	T-8	Capacity Material Size	2,500 gal Cross linked HDPE 8' dia x 7'-2" overall height

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
Caustic Feed Pumps	P-21, P-22, and P-23	Type Capacity Motor Data	Solenoid-driven diaphragm 3.3 gph @ 100 psig 1 ph, 60 Hz, 120 VAC
	P-unlabeled (to UVOX eff)	Type Capacity	Solenoid-driven diaphragm 1.5 gph @ 145 psig
Acid Storage Tank (Bulk 93% sulfuric acid)	T-9	Capacity Material Size	2,500 gal Cross lined HDPE 8' dia x 7'-2" overall height
Acid Feed Pumps	P-17 (to UVOX inf)	Type Capacity	Solenoid-driven diaphragm 1.5 gph @ 145 psig
	P-18, P-19, and P-20	Type Capacity Motor Data	Solenoid-driven diaphragm 3.3 gph @ 100 psig 1 ph, 60 Hz, 120 VAC
Chemical Precipitation Unit Rapid Mix Tank	ME-4	Rapid Mix Time	0.78 min @ 60 gpm
Mixer	ME-17	Type Motor Data	3 blade axial flow turbine 1/2 hp, 3 ph, 60 Hz, 230/460 VAC, 1800 rpm
Flocculation Tank	ME-5	Flocculation Time	4.5 min @ 60 gpm
Flocculator	ME-18	Type Motor Data	Paddle 1/2 hp, 3 ph, 60 Hz, 230/460 VAC 1800 rpm
Lamella Tank/Thickener	ME-6	Type Settling Area Hydraulic Capacity Sludge Storage Cap	Inclined plate settler 360 sq ft 145 gpm 2,000 gal

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
Chemical Precipitation Unit (con't) Sludge Rake	ME-19	Type Motor Data	Picket-fence 1/4 hp, 3 ph, 60 Hz, 230/460 VAC 1800 rpm
Sludge Pump	P-13	Type Capacity	Air diaphragm 100 gpm @ 120 psig
Sand Filter	ME-7	Type Filtration Area Media Media Depth Hydraulic Capacity Reject Rate Pressure Drop	Upflow continuous backwashing 12 sq ft 1.4 mm silica sand 40 inches 96 gpm 2 to 8 gpm 18 to 24 inches
pH Adjustment Tank	T-3	Capacity Retention Time Material Size	3,400 gal 1 hr @ 60 gpm Stainless steel 8' dia x 9' SWD
Mixer	ME-20	Type Motor Data	3 Blade axial flow turbine 2 hp, 3 ph, 60 Hz, 230/460 VAC, 1750 rpm
pH Adjustment Tank Pumps	P-6, P-7, and P-8	Type Capacity Motor Data  Intended Operation	Close-coupled, end-suction, TEFC 30 gpm @ 94 ft TDH 2 hp, 3 ph, 60 Hz, 230/460 VAC, 3500 rpm 2 on-line; 1 standby
GAC Contactor	ME-8 and ME-9	Capacity Carbon Type Mesh Size Carbon Quantity Pressure Rating Intended Operation	50 gpm Bituminous coal 8 X 30 1,500 pounds each 75 psig Series

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
In-line Mixer	ME-10	Size Flow Rate Pressure Drop	2-inch CPVC 27 to 60 gpm 1.1 to 5.3 psig
Effluent Flow Meter	FE/FE-801	Type	Magnetic
Sludge Storage & Thickening Tank	T-5	Capacity Material Size	7,400 gal Stainless steel 9' dia x 14' SWD w/ cone bottom
Mixer	ME-22	Type Motor Data	Dual 4 blade axial flow turbine 5 hp, 3 ph, 60 Hz, 230/460 VAC, 1725 rpm
Sludge Pump	P-14	Type Capacity	Air diaphragm 125 gpm
Filter Press	ME-12	Type Capacity No. of Plates Plate Size Max Inlet Pressure	Plate and frame 30 cu ft 24 1200 mm 100 psig
Diatomaceous Earth Feed System Tank	T-12	Capacity Material Size	500 gal Fiberglass
Mixer	ME-32	Type Motor Data	3 Blade axial flow turbine 2 hp, 3 ph, 60 Hz, 230/460 VAC, 1750 rpm
Body Feed Pump	P-32	Type Capacity	Air diaphragm 25 gpm
Filter Press Area Sump Pump	P-11	Type Capacity	Submersible 16 gpm

**TABLE 2-1**  
**EQUIPMENT LIST**  
**(CONTINUED)**

Component	Identification Number	Parameter	Design Information
Filtrate/Decant and Backwash Water Tank	T-4	Capacity Material Size	1,000 gal Stainless steel 5'-6" dia x 6' SWD
Filter/Decant Pumps	P-9 and P-10	Type Capacity Motor Data  Intended Operation	Close-coupled, end-suction, TEFC 30 gpm @ 34 ft TDH 3/4 hp, 3 ph, 60 Hz, 230/460 V AC, 3450 rpm 1 on-line; 1 standby
Vapor Phase Carbon	ME-26	Air Flowrate (avg.) Mesh Size Carbon Type Quantity	6 cfm 4x10 Bituminous coal 55 gal drum
Air Compressor and Receivers	ME-24	Type  Capacity Motor Data Receiver Additional Receivers	Duplex, oil-less, reciprocating, single-stage 51 scfm @ 100 psig each 15 hp, 3 ph, 60 Hz, 460 VAC each 240 gal 2 vertical rcvrs @ 240 gal each
Building Sump Pumps		Type Capacity	Submersible 16 gpm

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## Section 3

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**MONTGOMERY WATSON**



## 3.0 PROCESS CONTROL AND INSTRUMENTATION

### 3.1 GENERAL

The following text describes the overall instrumentation and control strategy for the PGCS and BWES facilities. In general, the control system consists of independent control panels for each major process unit and a main control panel which links all the independent units together and provides for their integrated operation. The operators can monitor the system using the annunciator panel and motor control center indicators or using the graphical displays on the personal computer which is located in the office. The operators need to input certain critical parameters (such as the treatment system flowrate, pH set points, and tank level setpoints) by using the computer. The extraction and treatment systems will automatically shut down based on two critical failures:

- UV oxidation unit failure
- or
- Effluent pH alarm

Either of these failures will activate the Auto Dialer which will then dial the telephone numbers programmed into the system. The operators can also manually shut down the system by pressing the **emergency stop** button on the main control panel or the one on the computer display. Failures of certain processes will cause a sequential shut down of other unit operations. For example, failure of the pH adjustment tank pumps will cause the water level in tank T-3 to rise, triggering the high-level alarm. With this alarm condition, the main PLC will stop the main influent pumps which stops flow to the treatment system and causes the units to sequentially shut down based on no flow.

Resetting of most alarms is automatic once the cause of the failure has been corrected. There are a few alarms that are manual, however, such as the high level alarm on the main equalization tank T-2. If this alarm is triggered, it most likely is an indication of pump failure or a problem in the process train. So the operator will need to check out the system and manually reset that alarm.

With the exception of the filter press which is a batch operation, the extraction and treatment systems are designed for continuous automatic operation 24 hours a day,

365 days a year. It is anticipated, however, that the system will be down approximately 10 to 15 percent of the time for maintenance. Details associated with instrumentation installation and wiring diagrams are included in Volume 5 (Instrumentation and Control Equipment Manual) of this O&M manual.

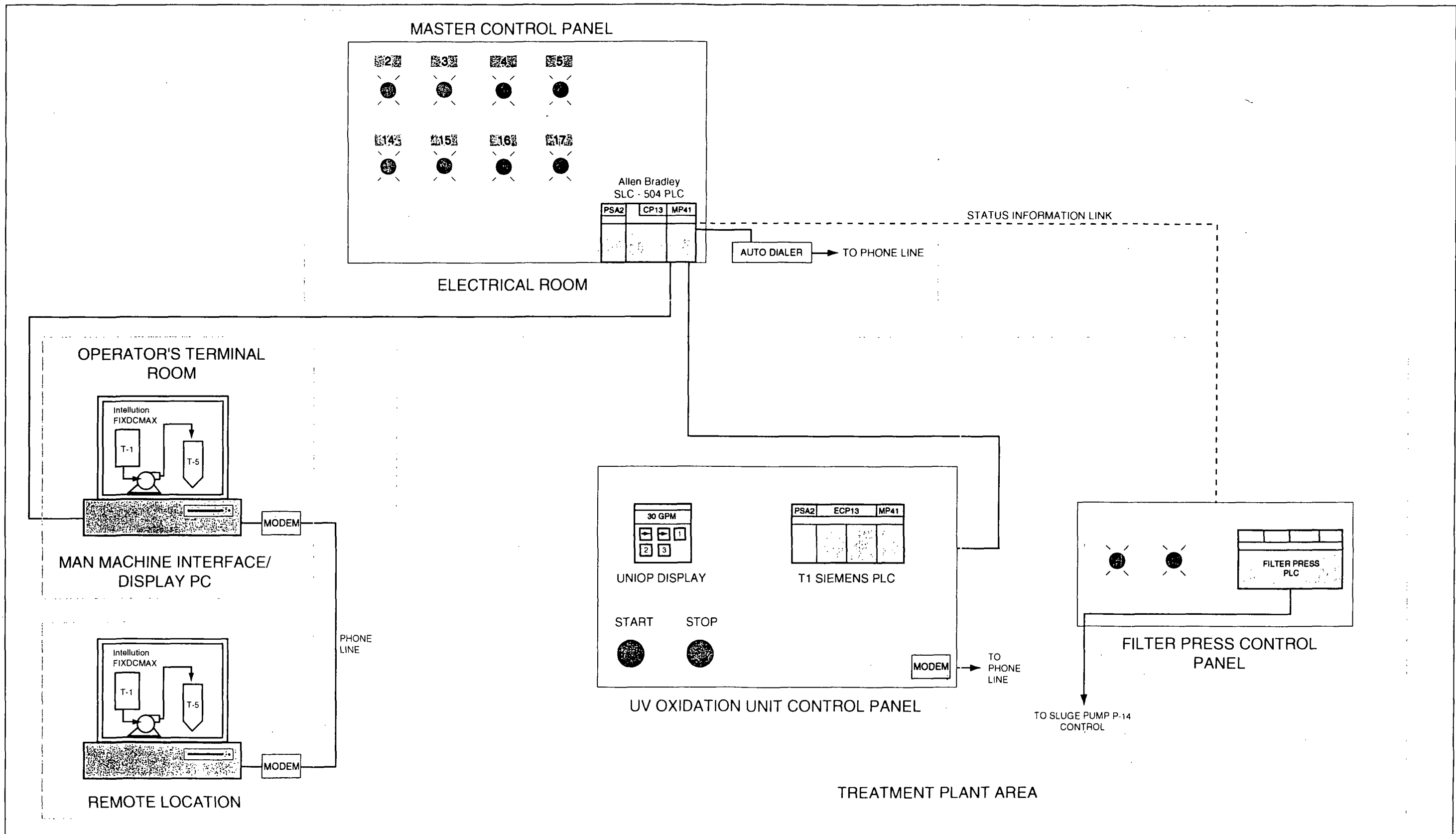
### **3.2 PROCESS CONTROL COMMUNICATION LINKS**

Figure 3-1 illustrates the communication link between the main process controllers. Only those units that actually have programming capability (i.e., they contain PLCs) are shown. Many other units such as the chemical precipitation unit, sand filter, flow meters, etc. have a control panel located on or next to the equipment, but these control panels primarily contain relays or switches to control the equipment and they cannot be programmed.

The main control panel is located inside the electrical room and it controls the overall operation of the entire groundwater extraction and treatment system. The UV oxidation unit has a PLC which controls the reactor and its associated chemical feed systems. The communication with the main control panel is for processing critical alarm shut downs, setting the UV oxidation unit flow rate, and for monitoring the UV oxidation unit status (on/off). The UV oxidation system PLC also includes a communication card and an external modem connection. This modem can be utilized for monitoring or modifying the PLC ladder logic program from a remote location via a telephone line. Detailed operations of the local PLC are included in Volume 6 (UV Oxidation O&M Manual) of this O&M manual.

The filter press also has a PLC which controls all of its functions and the operation of the sludge feed pump. The communication link between the filter press control panel and the main control panel is only for monitoring the filter press run status. Detailed operations of the local PLC are included in Volume 7 (JWI Filter Press O&M Manual) of this O&M manual.

Although not specifically shown in Figure 3-1, the air compressor operation is also independently controlled by a local control panel housed in the air compressor room. The air compressor on/off operation is controlled by a pressure switch, which is





adjustable for various high and low pressure set points. The air compressor needs a manual start following a power.

### 3.3 PROCESS CONTROL OF EACH SYSTEM

#### 3.3.1. PGCS Extraction Trench Pumps

Each of the electric submersible PGCS extraction pumps is automatically controlled by the main PLC and a level transmitter located in each of the sumps. The level transmitter sends a 4-20 mA signal to the main PLC. The PLC then sends a signal to the pump's motor starter which is located in the motor control center (MCC) in the electrical room. The water level in each extraction sump is also displayed on the computer screen. The pump operation is enabled (i.e., the pump is turned on) when the water level rises above 628 feet (USGS scale) and the level in tank T-2 is below 50 inches (adjustable parameter). When the water level in the extraction sump drops below 624 feet (USGS scale) or tank T-2 is above 70 inches (adjustable parameter) or tank T-1 reaches the high level alarm switch (LAH-1), the pump operation is disabled (i.e., the pump is shut off). The extraction pumps will not come back on line until the water level in T-2 is below 50 inches and the water level in T-1 is below LSH-1.

If the water level in the extraction sump rises above a user defined high-high level of 633 feet (USGS scale), an alarm is issued at the operator's terminal indicating a submersible pump failure. The idea of this alarm is to set the high-high level in the sump at an elevation below the normal water table level. If the pump cannot keep the water level in the sump depressed below this point, it means the pump has failed. For startup, the high-high level has been set at 633 feet because this is the typical water table elevation in the vicinity of the trench. **The operators will need to change this value as the trench begins to dewater the area and the general water table elevation drops.**

Each pump has a Hand-Off-Auto (HOA) switch located on the MCC so it can be turned off or operated manually. The computer screen also has a HOA switch which can be used to operate the pumps manually by clicking on Hand. In manual (Hand) operation, the low level shut off does not stop the pump, so it is important to monitor the water level to ensure that the pump is not run dry. An elapsed time meter and a cycle counter are also located on each pump's motor starter to indicate the number of pump starts and the

associated total run time. The operator's need to review this information to assess whether or not the pumps are cycling on and off too frequently. If so, the valve on the pump's discharge needs to be throttled back.

The combined influent line from the PGCS extraction trenches has a magnetic flow meter (FE/FIT-802) with instantaneous and totalized flow indication. The flow measurements can be read on the unit itself, but the flow data are also sent to the main PLC for tracking.

### **3.3.2. BWES Extraction Trench Pumps**

Each of the BWES extraction sumps is equipped with a submersible, bottom loading pneumatic pump (CEE Model AP-4). The pneumatic pumps are submerged with their inlets below static groundwater level and their operation is automatic. As the pump fills, an internal float rises until it comes in contact with an upper stop that is connected to a mechanical lever assembly which simultaneously opens an air supply poppet valve and closes an air exhaust poppet valve. As a result, air pressure builds up within the pump body and displaces the fluid contents up and out of the pump through a discharge ball check valve.

As the discharge cycle progresses, the float falls and prior to being completely empty, the float comes in contact with a lower stop that triggers the lever/valve assembly again, closing the air supply poppet and opening the air exhaust poppet. The pressurized air then exhausts and the pump is allowed to refill, beginning a new cycle. This cyclic operation continues automatically as the groundwater level is drawn down within the sump. An air pressure regulator is installed on the compressed air supply line in each sump vault to control the compressed air pressure to the pneumatic pumps thus controlling the effective flowrate.

All of the pneumatic pumps are expected to be continuously active. A pump will stop if the air compressor is shut down for maintenance, if water level drops below the low float in the pump or if a system shutdown alarm is activated. There is an electric solenoid valve located inside the treatment building on the main compressed air line supplying these pumps. The valves operation is controlled by the main PLC. The valve will close, thus shutting off the pumps, if there is a power failure or a system alarm condition. The

valve is opened after the alarm condition is reset and when the water level in tank T-1 is below LSH-1 and the level in tank T-2 is below 50 inches (adjustable).

The combined influent line from the BWES extraction trenches has a magnetic flow meter (FE/FIT-803) with instantaneous and totalized flow indication. The flow measurements can be read on the unit itself, but the flow data are also sent to the main PLC for tracking.

### **3.3.3. Phase Separator, Oil Storage Tank T-6, and Sludge Pump**

The phase separator does not have any instrumentation or control associated with it. The air diaphragm pump P-12 which is used to transfer sludge from the separator to the sludge storage tank is operated based on an adjustable timer in the main PLC (which can be adjusted from the computer screen) or it can be operated manually by turning the HOA switch located next to the pump to the Hand position. The oil storage tank T-6 has a high level switch (LSH-6) which triggers an alarm so the operators know it is time to empty the tank.

### **3.3.4. Pretreatment Tank T-1**

The pretreatment tank receives the effluent from the phase separator and blends/equalizes the water prior to being treated in the main process units. The pretreatment tank is equipped with level switches to provide operating range control for the tank mixer motor, pretreatment pumps (P-1 and P-2), and a high-high level alarm at the master control panel. When the water level in the tank rises to LSH-1, the mixer motor and lead pretreatment pump are started by the PLC. If the tank level drops below LSL-1, the PLC stops the mixer and operating pump(s). If the tank level rises to LSHH-1, the PLC starts the lag pretreatment pump. Only one pump should be needed, so if the second pump has to start, there is either a problem with the lead pump or the flow through the phase separator is above the intended design capacity. If the tank level rises to LAH-1, an alarm is sounded at the master control panel and the PLC stops all extraction pumps. On LAH-1 alarm, the tank level must drop below LSH-1 before the extraction pumps are re-started. The pretreatment pumps (P-1 and P-2) are automatically alternated on successive starts to even out the total operation time of each pump. If the lead pump fails, the lag pump will automatically be started and an alarm will be issued at the main

control panel. HOA switches are provided in the treatment plant area for both pumps and the mixer.

### **3.3.5. Equalization Tank T-2**

The main equalization tank receives water from the pretreatment equalization tank, the filtrate/decant sump, the process area floor sumps, and the PGCS extraction pumps. The tank is equipped with a level indicating transmitter to provide information for operating the mixer and the main process feed pumps.

The tank's level indicating transmitter LE/LIT-2 transmits the continuous tank level via a 4-20 mA signal to the main PLC (4 mA = 5.7 inches of water, 20 mA = 194 inches of water). When the water level is above 50 inches, the tank mixer and lead pump are started. All three influent pumps (P-3, P-4, and P-5) are equipped with variable speed drives, so once a pump is started, its speed is modulated via the PLC to maintain the flow rate which the operator must input into the system via the computer. The UV oxidation unit magnetic flow meter reports a 4-20 mA signal to the PLC to confirm that the desired flowrate is being maintained. A minimum of 10 gpm flow rate is required within the UV reactor to avoid over heating of the UV lamp.

If the lead pump on tank T-2 is unable to maintain the flowrate at the set point (for any reason), the lag pump is automatically started. When the lag pump is started, the PLC will automatically ramp down the lead pump speed to match the lag speed, and the pump speeds are ramped up and down together. If both pumps speed drops below 30 Hertz, indicating a reduced flow requirement, then the lag pump is stopped (first on—first off). Pump P-5 is alternated similarly with P-3 and P-4 in a first on—first off fashion to equalize run time. If the tank level drops below 15 inches of water, then the influent pumps and mixer are stopped. If the tank level rises above 130 inches, the pretreatment pumps, extraction pumps, and filtrate/decant tank pumps are stopped. A high level alarm will be annunciated on the operator's terminal, and the alarm must be manually reset on the terminal before the system will resume auto operation. On high level alarm, the tank level must drop below 15 inches before the pumps will resume operation. On high pH adjustment tank level of 96 inches, or UV oxidation unit failure, the pumps will be shut down. HOA switches are provided in the treatment plant area for the pumps and the mixer.



### 3.3.6. Flow Rate Set Point

The flowrate to the UV oxidation system is set by the operator at the computer. It is recommended that the treatment process be run as a continuous operation with as constant a flowrate as possible. Since the extraction pumps operate in a cyclic mode, the flowrate to the UV oxidation unit should be set at a flowrate slightly higher than the average daily flowrate from the PGCS and BWES extraction systems. In addition, the flowrate needs to take into account internal recycle streams. The following formula should be used to determine the flowrate set point:

$$Q_{\text{input}} = Q_{\text{PGCS Ext}} + Q_{\text{BWES Ext}} + Q_{\text{SFREJ}} + \sim 5\text{gpm}$$

where,

$Q_{\text{PGCS Ext}}$  is the average daily (24-hour) volume from the three PGCS extraction pumps divided by (24 x 60)

$Q_{\text{BWES Ext}}$  is the average daily (24-hour) volume from all BWES extraction pumps divided by (24 x 60)

$Q_{\text{SFREJ}}$  is the average daily flowrate of the sand filter reject (backwash) stream

### 3.3.7. UV Oxidation Unit

The UV oxidation unit is a complete package unit from Calgon Carbon Oxidation Systems. The package unit has its own local PLC-based control system which interfaces with the overall control system for the treatment plant. The package unit's control system controls the flow of Enox catalyst and hydrogen peroxide based on flowrate through the system. The local control panel also controls the acid feed to the UV unit influent and the caustic feed to the UV unit effluent via pH-based control loops.

The main PLC in the electrical room monitors the following items in the UV unit control panel.

1. System run status
2. Flowmeter flow rate 4 mA = 0 GPM, 20 mA - 50 GPM

The main PLC indicates if the UV unit is operating. For safety reasons, the UV unit is manually enabled to run at the UV control panel. The main PLC also monitors the flow signal from the UV unit. The PLC uses this signal to maintain a minimum flowrate through the unit of 10 GPM. The UV oxidation unit flow meter transmits a 4-20 mA signal to the MCP, which enables the operator to monitor the flowrate to the UV oxidation unit.

### 3.3.8. Chemical Precipitation Unit

The chemical precipitation unit is provided with a control panel mounted near the unit. This control panel has HOA switches for the rapid mix tank mixer (ME-17), the flocculator (ME-18), the sludge rake/thickener (ME-19), and the polyblend unit. When the switches are in Auto mode, any time process flow is detected by the UV system flow meter, the mixers and flocculators in the chemical precipitation unit are started and the solenoid valve on the water supply to the polyblend unit is opened. Polymer is pumped from its container and into the aging chamber of the polyblend unit by a chemical metering pump (p-25) supplied with the polyblend unit. The rate at which the polymer is fed into the polyblend unit is automatically adjusted by the main PLC. For example, as the flowrate through the treatment system increases, the amount of polymer injected into the polyblend unit is increased. The amount of water passing through the polyblend unit does not change. So effectively, the polyblend unit sends a more concentrated polymer solution to the rapid mix tank as the treatment system flowrate increases and a less concentrated polymer solution as the treatment system flowrate decreases. The initial polymer solution is adjusted by adjusting the chemical feed pump speed and the needle valve on the water supply line. The PLC resets the polymer feed according to the following influent flow as detected by the UV flow meter.

Flow	Polymer
0 GPM	4 mA
50 GPM	20 mA

If the influent flow discontinues, the water solenoid valve is closed and chemical pump P-25 is stopped.

The pH sensor PH-C-1 delivers a 4-20 mA signal to the main PLC which automatically injects acid and caustic to maintain the desired pH setpoint (which is an adjustable parameter).

The sludge pump P-13 is used to transfer sludge from the thickener portion of the chemical precipitation unit to the sludge storage tank T-5. This operation can be accomplished manually by turning the local HOA switch to Hand or it can be accomplished automatically based upon an adjustable timer in the main PLC.

### **3.3.9. Sand Filter**

The sand filter is a complete package unit with its own control panel mounted near the unit. The control panel sends a signal to the main PLC indicating its run status. The controls included in the panel are a backpressure gauge on the air supply to the airlift pump, a solenoid valve on the air supply line, and a rotameter on the air supply line. The sand filter also has a gauge to measure headloss across the sand bed. The sand filter contains an internal level switch that automatically enables/disables solenoid valve on the air supply line upon detection of water flow.

### **3.3.10. pH Adjustment Tank T-3**

The pH adjustment tank receives effluent from the sand filter and mixes it with acid to bring the pH within the acceptable discharge criteria. The pump also serves as a wet well for the effluent pumps. The tank has a mixer, chemical feed systems, and a level indicating transmitter. The level indicating transmitter LE/LIT-3 transmits a 4-20 mA signal to the PLC to report the continuous tank level (4 mA = 23.8 inches, 20 mA = 108 inches). A pH indicating transmitter (PH-3) transmits a 4-20 mA signal to the PLC to continuously report tank pH (4 mA = 0 pH; 20 mA = 14 pH).

When the tank level is between 50 inches and 70 inches, the PLC starts the mixer and lead pump. Pump speed is modulated via a variable speed drive to maintain a tank level set point of 60 inches. If the lead pump cannot maintain the set point, the lag pump

starts. When the lag pump is started, the PLC automatically ramps down the lead pump to match the lag speed. Then the PLC maintains equal pump speed and ramps both variable speed drives up and down together. When the speed of the two pumps drops below 30 Hz, indicating a reduced flow requirement, the lag pump is stopped. Pumps P-6, P-7, and P-8 are alternated on successive starts where the lag becomes the lead each time and the lead is stopped (first on–first off). If the tank level drops below 50 inches, the pumps and mixer are stopped. If the tank level rises above 96 inches, the influent pumps P-3, P-4, and P-5 are stopped, and a high level alarm is annunciated at the operator's panel. On a high level alarm, the tank level must drop below 92 inches before the pumps can resume operation.

The PLC maintains the pH at 7.5 by automatically injecting caustic if the pH is below set point, and acid if the pH is above the set point. High and low pH alarms of 9 and 6, respectively, are reported to the operator's terminal.

#### **3.3.11. Process Sump Tank T-4**

The process sump receives the reject or backwash water from the sand filter, the decant from the sludge thickening tank, the filtrate from the filter press, and water from the process area floor sumps. Two pumps (P-8 and P-9) are used to pump the liquid from T-4 into T-2. When the tank level rises above LSH-4, the lead pump is started and operated until the tank level drops below LSL-4. On successive starts, the pumps are alternated. If one pump fails, an alarm is displayed at the operator's terminal and the other pump automatically starts. If the tank level rises above LSHH-4, an alarm is issued at the main control panel.

#### **3.3.12. Sludge Storage and Thickening Tank T-5**

The sludge storage and thickening tank T-5 receives sludge from the phase separator and the chemical precipitation unit. The tank is equipped with a mixer to enhance thickening and a sludge pump (P-14) to transfer the sludge to the filter press. The tank also has four decant ports which can be used to decant off liquid from the upper portions of the tank.

The operation of the sludge pump P-14 is controlled by the filter press control panel and is discussed under that section. When the tank sludge level reaches level switch LAH-5,

an alarm is issued at the control panel indicating it is time to process sludge. When the sludge is above LSL-5, the mixer ME-22 is automatically energized. When the sludge is below this level, the mixer is turned off to avoid burning out the motor.

### **3.3.13. Peroxide Storage Tank T-7**

If fluid level drops below LSL-7, an alarm message will be issued to the operator's terminal to notify that it is time to refill peroxide tank.

### **3.3.14. NaOH Storage Tank T-8**

If tank level drops below LSL-8, an alarm is issued at the operator's terminal indicating it is time to refill the tank.

### **3.3.15. H<sub>2</sub>SO<sub>4</sub> Storage Tank T-9**

If the tank level drops below LSL-9, an alarm is issued at the operator's terminal it is time to refill the tank.

### **3.3.16. Floor Sump Pump P-11**

Pump P-11 is a self-contained unit with internal float switches to cycle the pump on/off to keep the floor sump under the filter press dewatered. Unit is self-contained and automatic. There is no connection to PLC system.

### **3.3.17. Process Area Floor Sumps and Pumps**

There are two sumps in the floor of the process area and each has a pump and a high level float switch LSH-10A and LSH-10B, respectively, that alarms the operator's terminal if the self-contained sump pump package fails. The high level alarm also energizes the auto dialer since it is likely that an overflow has occurred if the sump has filled to this level. The sump pump cycles on/off based on its internal float switch.

### **3.3.18. Chemical Metering Pumps for T-3 and Final pH Adjustment**

The chemical feed systems for the pH adjustment tank T-3 and for the final in-line pH adjustment of the effluent are controlled by the main PLC. Pump P-19 (acid feed) and P-22 (caustic feed) serve the pH adjustment tank. The pH sensor in the pH adjustment tank sends a 4-20 mA signal to the main PLC which automatically adjusts the dosing rate of P-19 and P-22 to maintain the adjustable pH set point of 7.5.

Pumps P-20 (acid feed) and P-23 (caustic feed) serve the final in-line pH adjustment of the effluent. The effluent discharge line contains a pH sensor (PH-801) that transmits a 4-20 mA signal to the PLC. The PLC adjusts the speed of P-20 and P-23 to maintain the adjustable pH set point of 7.5. The 4-20 mA signal from the PLC will adjust the dosing rate and the stroke length is adjustable from the manual control on the front of the pumps. If the pH drops below 5.5 or rises above 9.5 for more than 10 minutes (adjustable parameter), the PLC shuts down the entire treatment system and initiates a system fail alarm which energizes the auto dialer.

### **3.3.19. Chemical Metering Pumps for the Chemical Precipitation Unit**

The chemical feed systems for the chemical precipitation unit are controlled by the main PLC. Pumps P-18 (acid feed) and P-21 (caustic feed) serve the chemical precipitation unit. The pH transmitter in the flocculation tank transmits a 4-20 mA signal to the PLC (4 mA = 0 pH; 20 mA = 14 pH). The PLC adjusts the speed of P-18 and P-21 to maintain the adjustable pH set point. The 4-20 mA signal will affect the dosing rate. Stroke length is adjustable from the manual control on the face of the pump. If influent flow to the clarifier is stopped P-18 and P-21 are stopped.

### **3.3.20. Air Compressor**

A pressure switch (PS-701) on the air compressor alerts the operator's terminal if the air supply drops below an adjustable set point.

### **3.3.21. Filter Press**

The entire operation of the filter press is controlled by a control panel located on the unit. The panel controls the sequence of the dewatering process, and also the support systems which include the sludge feed pump (P-14), the diatomaceous earth (body feed and precoat) feed system, and the air supply to the press. The control panel sends a signal to the main PLC indicating run status.

### **3.3.22. Final Effluent Flow Monitoring**

The final effluent flowrate is monitored and recorded via magnetic flow meter FE/FIT-801.

## **3.4 MAIN CONTROL PANEL**

The Main or Master Control Panel is a Nema 12 enclosure housing an Allen-Bradley SLC-504 PLC system, and colorgraphic PC running Intelluiton F1XDCMAX software. The PC, PLC, and 24VDC power supply are protected by a Best UPS. All system I/O is assigned to continuous trend logs so the entire plant can be viewed over time. A HP laser jet printer prints logs and alarms. The full PC capability is remotely accessed by using PC Anywhere software. The colorgraphic screens will schematically depict the plant flow diagram with realtime variables superimposed.

The emergency stop button will stop the entire plant operation if depressed. The alarm horn is programmable to annunciate user selectable alarms.

## **3.5 H/O/A & VFD FUNCTIONS**

Table 3-1 describes the function of H/O/A switches and the VFDs. The operation of all of the process pumps and all mixers is controlled by the H/O/A switch.

**TABLE 3-1**

**H/O/A & VFD CONTROLS  
AMERICAN CHEMICAL SERVICES  
GRIFFITH, INDIANA**

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<b>AUTO</b>	When the switch is in this position the PLC will turn on and off the pump or mixer as described in the sequence of control.
<b>OFF</b>	The pump or mixer will stay off. (Note: it is recommended when servicing a device that the device is to be locked out with a padlock, not just turned off.)
<b>HAND</b>	The pump or mixer will run continuously regardless of conditions.
<b>VFD's</b>	The speed of the VFD's in the hand mode will be controlled from each VFD's speed control knob located at the motor control center.

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### **3.6 TROUBLESHOOTING GUIDANCE**

Table 3-2 describes the troubleshooting guidance for various process alarms and failures encountered in the treatment system operation.

TABLE 3-2

**INSTRUMENTATION AND CONTROLS TROUBLESHOOTING GUIDANCE  
AMERICAN CHEMICAL SERVICES  
GRIFFITH, INDIANA**

Item	Description and Probable Cause	Corrective Action
<b>TANK #1</b>		
<b>Influent Pre-treatment Tank</b> High Level Alarm	Tank-1 high level switch is activated and signals LAH-1. P-1 and P-2 should both be running if control is in Auto. Influent flow is too high or P-1 or P-2 failure.	<ol style="list-style-type: none"> <li>1. Turn off the pump(s) transferring water to this tank.</li> <li>2. Check the fuse and wiring to the float switch.</li> </ol>
Pumps #1, #2, and Mixer-15 Failure	Pump or mixer failed to start when commanded. Power has been disconnected, the motor starter overloads have been tripped, or the bus fuses have blown.	<ol style="list-style-type: none"> <li>1. Push the overload reset button on the motor control center for failed pump.</li> <li>2. Visually check the power disconnect switch. If the power switch is on - check the following.               <ol style="list-style-type: none"> <li>a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. (<b>Note: 480 volts AC, be careful, can be fatal</b>) replace fuses if necessary.</li> </ol> </li> <li>3. Check status fuses in control panel. See wiring diagram for details.</li> </ol>
<b>TANK #2</b>		
<b>Influent Equalization Tank</b> High Level Alarm	Tank-2 high level has been reached, level defined by user. One of the three pumps P-3, P-5, or P-5 should be running at the user defined flow setpoint. Influent pumps turn off level at Tank-2 is too high compared to the high alarm value. Multiple pumps have failed. The level transmitter might be sending a false reading.	<ol style="list-style-type: none"> <li>1. Check if influent pumps are in hand.</li> <li>2. Compare the level in tank-2 at which the pumps turn on with the high level alarm.</li> <li>3. Check the VFD's for pumps #3, #4, and #5 for faults.</li> <li>4. Check the power going to level transmitter (24Vdc) and for proper operation.</li> </ol>
Pumps #3, #4, #5, and Mixer-16 Failure	Pump or mixer failed to start when commanded. Power has been disconnected, the VFD has faulted, or the bus fuses have blown.	<ol style="list-style-type: none"> <li>1. Check if there is a fault code on the VFD. If there is look up the code in the VFD User Manual and correct the problem.</li> <li>2. Visually check the power disconnect switch. If the power switch is on - check the following, if the drive has no power:               <ol style="list-style-type: none"> <li>a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. (<b>Note: 480 volts AC, be careful, can be fatal</b>) replace fuses if necessary.</li> </ol> </li> <li>3. Check status fuses in control panel. See wiring diagram for details.</li> </ol>

TABLE 3-2

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**TANK #3**

**pH Adjustment Tank**  
 High Level Alarm

Tank-3 high level has been reached, level defined by user.  
 Multiple pumps have failed; pumps #6, #7, and #8 serve Tank-3.  
 The pump enable level is higher than Tank-3 high level alarm.  
 The level transmitter might be sending a false heading.

1. Compare the high alarm level with the pump enable level.
2. Check the VFD's for pumps #6, #7, and #8 for faults.
3. Check the power going to level transmitter (24 Vdc) and for proper operation.

Pumps #6, #7, #8, and Mixer-20  
 Failure

Pump or mixer failed to start when commanded.  
 Power has been disconnected, the VFD has faulted, or the bus fuses have blown.

1. Check if there is a fault code on the VFD. If there is look up the code in the VFD User Manual and correct the problem.
2. Visually check the power disconnect switch. If the power switch is on - check the following, if the drive has no power:
  - a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. **(Note: 480 volts AC, be careful, can be fatal)** replace fuses if necessary.
3. Check status fuses in control panel. See wiring diagram for details.

**TANK #4**

**Process Sump Tank**  
 High Level Alarm

Tank-4 high level float switch has been reached (LSHH-4)  
 Both pumps #9 and #10 should be running.  
 Both pumps probably have failed or Tank-4 level was high when the filter press cycle started.

1. Check the pumps #9 and #10 for operation.
2. Check if filter press has started a cycle.
3. Check the float switch and power going to it.

Pumps #9 and #10 Failure

Pump failed to start when commanded.  
 Power has been disconnected, the motor started overloads have been tripped, or the bus fuses have blown.

1. Push the overload reset button on the motor control center for failed pump.
2. Visually check the power disconnect switch. If the power switch is on - check the following, if the drive has no power:
  - a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. **(Note: 480 volts AC, be careful, can be fatal)** replace fuses if necessary.
3. Check status fuses in control panel. See wiring diagram for details.

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**TANK #5****Sludge Storage and Thickening Tank****High Level Alarm**

Tank-5 high level switch has been reached (LAH-5).  
 Tank-5 needs to be emptied by running the filter press.  
 All backwash valves are close to Tank-4.  
 The high level switch might have failed.

1. Run a filter press cycle to decrease level in Tank-5.
2. Check the backwash valves to Tank-4.
3. Check the power and fuse going to the high level switch.
4. Check the high level switch.

**Mixer-22 Failure**

Mixer failed to start when commanded.  
 Power has been disconnected, the motor starter overloads have been tripped, or the bus fuses have blown.

1. Push the overload reset button on the motor control center for failed pump.
2. Visually check the power disconnect switch. If the power switch is on - check the following, if the drive has no power:
  - a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. (**Note: 480 volts AC, be careful, can be fatal**) replace fuses if necessary.
3. Check status fuses in control panel. See wiring diagram for details.

**TANK #6****Oil Storage Tank****High Level Alarm**

Tank-6 high level float switch has been reached (LSH-6).  
 The oil storage tank needs to be emptied.

1. Empty oil storage Tank-6.
2. Check power and fuse going to the high level float switch.

**TANK #7****Peroxide Storage Tank****Low Level Alarm**

Tank-7 low level switch has been reached (LSL-7).  
 The peroxide tank needs to be refilled.

1. Refill the peroxide Tank-7.
2. Check power and fuse going to the low level float switch.

**TANK #8****Sodium Hydroxide Tank****Low Level Alarm**

Tank-8 low level switch has been reached (LSL-8).  
 The sodium hydroxide tank needs to be refilled.

1. Refill sodium hydroxide Tank-8.
2. Check power and fuse going to the low level float switch.

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**TANK #9**  
**Sulfuric Acid Tank**  
 Low Level Alarm

Tank-9 low level switch has been reached (LSL-9).  
 The sulfuric acid tank needs to be refilled.

1. Refill the peroxide Tank-9.
  2. Check power and fuse going to the low level float switch.
- 

**SUMP 10A & 10B**  
**Floor Sumps**  
 High Level Alarm

Sump pits 10A or 10B high level float switch has been reached.  
 Sump pump 10A or 10B has failed. The float switch has a loss of

1. Check the sump pump for operation.
  2. Check power and fuse going to the float switch.
- 

**CLARIFIER MIXERS**  
 Mixers #17, #18, and #19

Mixer failed to start when commanded.  
 Power has been disconnected, the motor starter overloads have been tripped, or the feed breaker has blown.

1. Check if the motor starter overload or breaker is tripped for that mixer in the clarifier control panel.
  2. Check if the 480VAC panel feed breaker is tripped.
  3. Check status fuses in control panel. See wiring diagram for detail.
- 

**PGCS EXTRACTION PUMPS**  
 Pumps #1, #2, and #3 Failure

Pump failed to start when commanded.  
 Power has been disconnected, the motor-starter overloads have been tripped, or the bus fuses have blown.

1. Push the overload reset button on the motor control center for failed pump.
  2. Visually check the power disconnect switch. If the power switch is on - check the following, if the drive has no power:
    - a. disconnect the power switch and check continuity of the fuses with an ohm meter or check for voltage on the load side of the fuse. (Note: 480 volts AC, be careful, can be fatal) replace fuses if necessary.
  3. Check status fuses in control panel. See wiring diagram for details.
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**pH ALARMS**

Clarifier High pH Alarm	The pH in the clarifier is above the high alarm setpoint, user defined, for 10 minutes. The pH setpoint is higher than the pH high alarm setpoint. The acid pump P-18 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.	<ol style="list-style-type: none"> <li>1. Compare the pH setpoint with the pH high alarm setpoint.</li> <li>2. Check the pH pumps P-18 and P-21 for proper operation.</li> <li>3. Check Tank-9 acid level.</li> </ol>
Clarifier Low pH Alarm	The pH in the clarifier is below the low alarm setpoint, user defined, for 10 minutes. The pH setpoint is lower than the pH low alarm setpoint. The base pump P-21 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.	<ol style="list-style-type: none"> <li>1. Compare the pH setpoint with the pH low alarm setpoint.</li> <li>2. Check the pH pumps P-18 and P-19 for proper operation.</li> <li>3. Check Tank-8 base level.</li> </ol>
Tank-3 High pH Alarm	The pH in Tank-3 is above the high alarm setpoint, user defined, for 10 minutes. The pH setpoint is higher than the pH high alarm setpoint. The acid pump P-19 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.	<ol style="list-style-type: none"> <li>1. Compare the pH setpoint with the pH high alarm setpoint.</li> <li>2. Check the pH pumps P-19 and P-22 for proper operation.</li> <li>3. Check Tank-9 acid level.</li> </ol>
Tank-3 Low pH Alarm	The pH in the clarifier is below the low alarm setpoint, user defined, for 10 minutes. The pH setpoint is lower than the pH low alarm setpoint. The base pump P-22 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.	<ol style="list-style-type: none"> <li>1. Compare the pH setpoint with the pH low alarm setpoint.</li> <li>2. Check the pH pumps P-19 and P-22 for proper operation.</li> <li>3. Check Tank-8 base level.</li> </ol>

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Effluent High pH Alarm	<p>The pH in Tank-3 is above the high alarm setpoint, user defined, for 10 minutes. The pH setpoint is higher than the pH high alarm setpoint. The acid pump P-20 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.</p>	<ol style="list-style-type: none"><li>1. Compare the pH setpoint with the pH high alarm setpoint.</li><li>2. Check the pH pumps P-20 and P-23 for proper operation.</li><li>3. Check Tank-9 acid level.</li></ol>
Effluent Low pH Alarm	<p>The pH in the clarifier is below the low alarm setpoint, user defined, for 10 minutes. The pH setpoint is lower than the pH low alarm setpoint. The base pump P-23 is not working. The PLC program is not working correctly. A drastic pH change in the system has taken place.</p>	<ol style="list-style-type: none"><li>1. Compare the pH setpoint with the pH low alarm setpoint.</li><li>2. Check the pH pumps P-20 and P-23 for proper operation.</li><li>3. Check Tank-8 base level.</li></ol>

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## **Section 4**

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**MONTGOMERY WATSON**



## **4.0 FACILITY START-UP**

### **4.1 OVERVIEW**

This section discusses the initial start-up and performance testing of the PGCS and BWES facilities. These procedures are also applicable for future start-up after long-term maintenance or power shutdowns. Prior to start-up, the operations staff should familiarize themselves with all vendor supplied instructions and procedures for start-up, operation, and maintenance of individual equipment components.

The initial start-up activities involve three stages:

- Facility water testing including leak testing and individual equipment testing and calibration.
- Start-up and process adjustment to tune facility operations under normal flow conditions.
- Performance testing at the design flow conditions.

This section describes the start-up procedures for the overall facility. Detailed start-up and operations procedures for the individual equipment are discussed in Sections 5.0 (Groundwater Extraction Systems), 6.0 (Pretreatment Facilities), 7.0 (Main Treatment Facilities), and 8.0 (Support Systems) of this plan.

### **4.2 WATER TESTING PROCEDURES**

Before initial start-up, all equipment should be checked and mechanically tested to ensure that each piece of equipment is water tight or air tight and has no faulty mechanical parts. Each vendor-provided control program should also be tested before and after installation. Each control loop should be tested according to signal and control logic. In addition to the individual equipment testing, a system water test should be performed to ensure the integrity of the treatment system as a whole. For a detailed and specific list of items to be

checked prior to start-up, the operators should refer to the Start-Up and Construction Inspection QA/QC Log.

#### **4.2.1. Initial Leak Test**

An initial water test should be conducted on the tanks, vessels, and piping to check for leaks. During this test, individual tanks and pipes should be filled with potable water or clean site water and all connections, fittings, and valves should be observed for leaks. Following testing, repairs should be made as necessary and the equipment and piping should be retested to ensure the leaks have been properly repaired. Clean water testing of the extraction systems is not possible, but the conveyance piping and air supply piping should be pressure tested at this time. The utility supply lines should also be tested.

#### **4.2.2. Functional Test Of Individual Equipment**

After the treatment system has been checked for leaks and any repairs made, a functional test should be conducted on each process unit. Potable or clean site water should again be used for this test and the water should be recycled as much as possible to reduce the overall water consumption required for testing. The main purpose of this test is to check the function of each process component. All controls, alarms, valves, pumps, and motors should be verified for proper function. The functional test requirements for the major components of the extraction and treatment systems are listed in Table 4-1. As stated previously, a more detailed list can be found in the Start-Up and Construction Inspection QA/QC Log.

The functional test should be conducted by first filling the pretreatment equalization tank (T-1) with clean water. The test essentially involves moving the water from one process to the next. As each process or instrumentation loop is checked out, the water is pumped to the next process so it can be checked out. The oil separator, oil storage tanks, chemical feed systems, effluent conveyance and discharge systems, and sludge processing facilities should all be tested at this time.

**TABLE 4-1**  
**FUNCTIONAL TEST REQUIREMENTS FOR PROCESS UNITS**

<b>Process Unit</b>	<b>Operational Test</b>
Phase Separator	Weir positioning, sludge pump operation, valve operation
NAPL Storage Tank	Level indicator, high-level alarm, valve operation, air release valve
Sludge Storage/Thickening Tank	Level indicator, high-level alarm, mixer on/off/auto operation, air release valve
Equalization Tanks	Level indicators, high-level alarms and shutdowns, pump controls, mixer on/off/auto operation, air release valves
UV Oxidation Unit	UV lamp, vendor PLC operation and interface, chemical addition, catalyst addition, alarms and shutdowns
Chemical Precipitation Unit	Vendor controls, pH control loop
Filter Press	Vendor PLC, body feed control, sludge pump operation, plate shifter
Upflow Sand Filter	Vendor PLC, air and water flow control, backwash control
pH Adjustment Tank	Level indication and alarms, pH control loop, mixer operation, pump control, air release valves
GAC Contactors	Valve operation to switch lead/lag, pressure gauges
Peroxide, Caustic, And Acid Storage Tanks	Level indicators, low-level alarms
Metering Pumps	On/off/auto operation, automatic flow adjustment based on PLC input
Effluent Monitoring	Flow meter operation, pH control
Sumps	Pump on/off, high-level alarms, pump on alarm
Process Air System	Process air collection

#### **4.2.3. Overall Treatment System Water Test**

At the conclusion of the functional test on the individual equipment, the entire system should be tested with clean water. At this point, tanks T-1 and T-2 should be filled with water and the treatment system should be operated at a flowrate of 60 gpm continuously for at least 24 hours by recycling the water back to the equalization tanks through the off-spec effluent piping. It may be necessary to add more clean water to the equalization tanks in order to conduct this part of the test. During this stage, the PLC control sequences should be tested to ensure that all "system" failures, shutdowns, alarms, interlocks with the extraction pumps, etc. are functioning properly. The chemical feed systems should also be in operation and should be delivering their respective chemicals. Each piece of equipment and connecting piping should be inspected for integrity and leakage. Adjustment and recalibration of the field instrumentation system should be performed as needed. At the end of this part of the clean water test, the water should be released through the effluent pipe and discharge structures to test their function and integrity.

After the clean water test is completed, all tanks and equipment should be reset to the start-up conditions as specified by the manufacturer's equipment manuals. All valves and control settings should be checked for correct position. All pumps, blowers, motors, and moving parts should be checked for proper lubrication.

#### **4.2.4. Extraction System Test**

Since the extraction systems cannot be tested until they are brought on-line, they will be tested as part of the start-up process after the entire treatment system has been tested out on clean water. Testing of these facilities is therefore discussed under the next section.

### **4.3 START-UP AND PROCESS ADJUSTMENT**

Once the clean water test is successfully completed, the facility start-up operation can commence. During the initial stage of the facility start-up, efforts should focus on optimization of process setpoints, acclimation of the individual systems to the PGCS groundwater, and optimization of chemical feed rates.

#### **4.3.1. Critical Components**

Although all treatment components are essential to maintain the operating conditions of the facility, a few major components are most critical for achieving the treatment goals. The significance of these systems is vital during start-up of the PGCS and BWES. These systems include the phase separator, UV Oxidation system, the chemical precipitation unit, and the carbon contactors.

The phase separator must remove the majority of the NAPL from the groundwater. The NAPL will overload or interfere with the performance of the main treatment systems. It is, therefore, essential that NAPL separation at the phase separator is effective and also that all streams containing even a trace amount of NAPL be diverted to this pretreatment system. In addition, it is likely that water initially entering the plant may have high levels of solids. By routing the initial flows through the phase separator, these solids can be removed and will not present a problem for the main treatment units.

The UV oxidation system is the main treatment unit for organic removal. The UV lamp in the UV oxidation system and the chemical feed rates have to be tuned not only to the flow rate but also to the incoming concentration of contaminants. The success of the treatment system depends on the operation of the UV oxidation system. It is, therefore, critical to carefully adjust the UV oxidation system during the start-up phase.

The chemical precipitation unit is the main treatment for metals in the groundwater. Inadequate performance of this unit could cause non-compliance with the discharge standards.

Although the carbon contactors may not be used in the long run, they are critical to successfully starting up the system. The carbon will serve as a backup to remove any organics and even some inorganics that pass through the primary treatment processes during this initial startup phase. It is critical that the carbon contactors be on-line and fully operational during this period.

### 4.3.2. Overview of System Start-Up and Adjustment

The following text presents the general plan for starting up the PGCS and BWES facilities. Detailed start-up procedures for specific units or systems is discussed in subsequent sections of this plan.

**4.3.2.1. PGCS Extraction System.** As stated in Section 1.6.3.1, the PGCS extraction trenches and the BWES extraction trenches cannot be brought on-line at the same time. The PGCS trenches should be brought on-line first and the BWES trenches should be brought on-line approximately 30 days later. Start-up and testing of the PGCS extraction system should be conducted by initially starting each of the pumps and verifying that they operate (start/stop) as intended. Two of the three pumps should then be shutoff while the operation of the third pump is fine tuned by adjusting the throttling valve and the level probes as necessary. The other extraction sumps should be visually inspected to make sure there is no evidence of backflow from the operating pump. The flowrate from the operating pump should also be recorded. If possible, the extracted groundwater should be routed through the oil separator during the start-up phase.

Once the first pump is operating as desired, the second pump should be brought on-line and adjusted to the desired operating range. The combined flowrate from the two pumps should be recorded and then the third pump should be brought on-line and adjusted. The flowrate from all three pumps should be noted and recorded.

The extraction system is to be operated until both equalization tanks (T-1 and T-2) are essentially full. The tanks hold a combined volume of approximately 8,000 gallons. The extraction system should then be shutdown (or it should shutdown automatically based on high level in the tanks). This will complete the start-up phase of the PGCS extraction system.

When T-1 and T-2 are about 3/4 full, samples of the water should be collected and sent to a laboratory for quick (24-hour) turnaround analysis of VOCs, SVOCs, COD, and general water quality parameters (including iron). These data are essential for setting the chemical feed dosages and adjusting the process unit operating parameters.

**4.3.2.2. Treatment System.** Upon completing the start-up and testing of the PGCS extraction system, the treatment system should be brought on-line to treat the volume of water stored in tanks T-1 and T-2. The analytical data on the water in the tanks should be used as the basis for initial settings on the chemical feed systems and the oxidation system. Start-up consists of running the contaminated water from T-2 through the oxidation unit, chemical precipitation unit, sand filter, pH adjustment tank, GAC contactors, final in-line pH adjustment and then into a temporary 20,000 gallon storage tank. Temporary piping is necessary to discharge into the storage tank. For this phase of the startup, the treatment system should be operated at a flowrate of 60 gpm. As tank T-2 empties, the water from T-1 should be pumped to T-2. One of the PGCS extraction sump pumps should then be operated to pump additional water to tank T-1. The intent is to process approximately 18,000 gallons of water and then shut down the entire system, take samples of the treated water, and send them to the appropriate laboratories for the respective analysis (as stated in the PSVP) with 24-hour turnaround.

If the analytical results show that the treated water is in compliance with the effluent limitations, the water can be discharged to the wetlands. If the water is not in compliance, it should be recycled back to the equalization tanks, processed again, and resampled.

Once the first batch has been discharged to the wetlands, the PGCS extraction trench pumps should be turned back on. After tanks T-1 and T-2 fill to the appropriate levels, the treatment system should automatically come on-line. The system is to be operated continuously (24 hours/day) for three consecutive days at a flowrate of 60 gpm. During this period, the effluent should be discharged to the wetlands and sampling should be conducted in accordance with the PGCS PSVP.

**4.3.2.3. BWES Extraction System.** Start-up of the BWES extraction trenches should take place after (1) the initial inspection and testing of the extraction and conveyance facilities has been completed, (2) the PGCS extraction system flowrate has dropped to about 26 gpm, and (3) the treatment system has been started up and successfully fine tuned to handle the PGCS water. Each pump should be started to verify that they operate (start/stop) as intended. The operation of each extraction pump should then be adjusted in the same manner as the PGCS extraction system. One trench/pump should be brought

on-line, tested, adjusted, and its flowrate recorded. Then the second trench/pump should be brought on-line and so on until all trenches/pumps are on-line. All water from the start-up activity should be routed to tank T-1. Once all BWES extraction pumps are operating, the system should be allowed to operate for approximately 30 minutes and then shutdown. This is necessary to avoid hydraulically overloading the treatment system as discussed in the Section 1.0.

During start-up, samples of the groundwater from each trench should be sampled and sent to a laboratory for analyses of COD, VOCs, SVOCs, PCBs, metals, and general minerals. This information is to be used in creating a mixture for proveout of the treatment system and in adjusting the chemical feed rates.

#### **4.4 PERFORMANCE TESTING**

##### **4.4.1. PGCS Extraction System**

Performance testing of the PGCS extraction system will occur after startup of the treatment system. Performance testing consists of simply letting the extraction system operate and periodically taking water level measurements from select piezometers and monitoring wells. The frequency and procedures for taking the water level measurements and the specific piezometers and monitoring wells to be used are described in the PGCS Performance Standard Verification Plan (PSVP).

##### **4.4.2. BWES Extraction System**

Performance testing of the BWES extraction system should be conducted after the flowrate from the PGCS extraction trench has decreased to approximately 26 gpm. This is expected to take about 30 days after start-up of the treatment system. Once the extraction system is on-line, proveout consists of simply letting the extraction system operate and periodically taking water level measurements from select piezometers. The frequency and procedures for taking the water level measurements and the specific piezometers to be used are described in the BWES Performance Standard Verification Plan (PSVP). In addition to the water levels, the PSVP states that pump discharge data



also need to be recorded for purposes of demonstrating the extraction system performance.

Once the BWES is on-line, operating personnel should sample the influent on a daily basis for 5 days following startup of the BWES trenches, and, based on the results, make the appropriate modifications to the treatment system to accommodate the flow from the BWES. The BWES water is expected to contain much higher levels of contamination, so this will be a critical period for the treatment system.

#### **4.4.3. Treatment System**

Performance testing or proveout of the treatment system will need to be delayed until after the BWES extraction trenches are on-line. This is necessary because the water from the PGCS trench will not have high enough levels of contamination to approximate the design influent condition which the treatment system, in particular the oxidation system, must treat. Once the BWES trenches are on-line, high enough levels of contamination can be expected in the facility influent to approximate the design influent and proveout the treatment system with respect to contaminant removal efficiency. If the BWES extraction systems are brought on-line sooner than anticipated to control the rising water table within the barrier wall, it may be necessary to analyze the influent and make the appropriate adjustments to the treatment system to assure that the effluent is in compliance.

In general, the proveout should be conducted by filling tanks T-1 and T-2 with a mixture of contaminated water from both the BWES and PGCS extraction trenches which approximates the design influent condition as stated in the performance guarantee with Calgon. [A sample of the BWES water should be collected prior to this step, as described under BWES Startup.] As the influent mixture is being prepared, samples of the water are to be taken and analyzed for COD. The COD data should be used to determine when the COD of the mixture is approximately that of the design influent. At that point, the operators should collect samples and send them to a laboratory for 24-hour turnaround analysis of VOCs, SVOCs, metals, and general water quality parameters.

The combined influent is to be processed through the treatment system at a flow rate of 40 gpm. During this phase, the treated effluent should be routed into a 20,000 gallon temporary storage tank. A minimum of 7,000 gallons, but no more than 18,000 gallons should be processed. [We want to accomplish this in one day.] The effluent from the oxidation unit and the final effluent should be sampled and sent to the appropriate laboratories for the respective analysis (as stated in the PGCS PSVP) with 24-hour turnaround.

If the data show that the effluent is in compliance and that the oxidation unit achieved the required removal efficiencies, the treated water should be pumped into the effluent discharge line and the extraction and treatment systems should be brought back on-line. If the data indicate that the effluent is not in compliance, the water should be reprocessed and tested until it can be discharged. The entire proveout should then be repeated. If the effluent meets the discharge criteria, but the effluent from the oxidation unit shows that the unit did not meet the performance objectives, Calgon should be notified immediately. With direction from Calgon, the unit should be adjusted and the test rerun.

Proveout of the sludge handling system, in particular the filter press, can not occur until sufficient sludge has been generated to allow operation of these facilities. Proveout essentially consists of running a cycle and sending a sample of the sludge feed and sludge cake to a laboratory for solids analysis.

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## **Section 5**

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**MONTGOMERY WATSON**

## **5.0 GROUNDWATER EXTRACTION SYSTEMS STARTUP AND OPERATION**

### **5.1 INTRODUCTION**

This section provides an overview of the startup procedures, operation and maintenance requirements, and trouble shooting of the PGCS extraction system and the barrier wall extraction system. The procedures outlined in this manual are developed to minimize system upsets, provide operational safety, and to reduce operating costs for the system.

Included as part of this O&M manual are the pertinent equipment data, shop drawings, and specifications. Volumes 5 through 8, Equipment Manufacturer's Manuals, contains specific equipment information furnished by the manufacturers, while the text refers to the performance specifications.

### **5.2 EXTRACTION SYSTEMS STARTUP**

Startup of the groundwater extraction systems includes start up of the PGCS and BWES extraction trenches, startup of the electric submersible pumps in the PGCS extraction trenches, and startup of the pneumatic pumps in the BWES extraction trenches. The following sections provide an overview of the startup procedures after a system shut down condition for each component of the extraction system. Refer to as-builts drawing (M-4) included in Volume 4 of the O&M Manual for various valve locations.

#### **5.2.1. PGCS Extraction Pumps**

After the pumps have been set into the sumps and the wiring connections are complete, the following procedures are to be performed:

- Set the HOA switch for pumps at the local control panel to AUTO.
- Open valve V-01A.
- Open valve V-04 completely. Close valves V-02, V-03, and V-05.
- Verify that sample port V-36 is closed.
- Flip the power switch to ON position.
- Verify that influent valve to influent equalization tank (T-2) is open.

Once water begins to flow in the conveyance pipe, perform the following procedures:

- Check and record the voltage and current drawn on each lead motor.
- Check flow meter FM-802 and totalizer on the PLC in the facility.
- Adjust flow rate to the desired setting.
- Verify pump operation corresponds to the level switch sequence setting.
- Verify alarm conditions.
- Check the pumps for leaks, normal noise, vibration, alignment and lubrication.

Repeat the above procedures for the remaining two pumps.

### **5.2.2. BWES Extraction Pumps**

After the pumps have been set into the sumps and the compressed air and discharge piping connections are complete, the following procedures are to be performed:

- Open valve V-01B.
- Open valve V-04 completely. Close valves V-02, V-03, and V-05.
- Verify that sample port V-47 is closed.
- Verify that influent valve to influent equalization tank (T-2) is open.
- Follow the procedures for startup of the air compressor (ME-24) which are discussed in Section 8.0.
- Open influent and effluent valves to the air filter/regulator.
- Open air supply valve(s) between the compressed-air source and the pump control panel.
- Adjust the air supply pressure to desired settings at the air compressor control panel.
- Open discharge ball valve at well that is farthest from the compressed air source.

Once water began to flow in the conveyance pipe, the following procedures were performed:

- Observe flow (FM-803) from the pump farthest from the compressed air source. Adjust discharge ball valve and air pressure at the pump regulator until desired flow rate is achieved from the pump.
- Open discharge ball valve at the pump that is next dominant, i.e., the pump that is next farthest from the compressed air source.
- Observe flow (FM-803) from pump farthest from the compressed air source. Adjust discharge ball valve and air pressure at the pump regulator until desired flow rate is achieved from the pump.
- Follow the above-described sequence for the remaining pumps.
- Check flow meter (FM-803) and totalizer readings (local display).
- Adjust flow rate from each pump until the desired total flow rate is achieved.

### **5.2.3. Extraction Trenches**

The following steps were taken during initial startup and should be taken whenever the extraction system is shutdown and restarted:

- Verify that the influent valves to the PGCS treatment facility are open.
- Verify that electric power and air supply to pumps is operational and that the pumps are set for normal operations.
- Once groundwater starts to flow through the conveyance piping, adjust both the air supply to the pumps inside the trenches and the level indicating transmitter settings from the central control station computer screen; for the desired flow rate.

## **5.3 NORMAL OPERATIONS**

The groundwater extraction and conveyance systems are designed to operate continuously, automatically, and unattended except for normal maintenance. Procedures for the system operation are outlined below. The interactions of each control system are described in the following sections as they are encountered in the treatment system. Volume 5 (Instrumentation and Control Equipment Manual) contains a description of the instrumentation and control system components and manufacturer's literature.

### **5.3.1. Extraction Trenches**

After the initial startup of the PGCS extraction system, the drawdown at each trench needs to be monitored. If the desired drawdown is not being achieved, the low level shutoff, high level start, and discharge valve position should be checked and adjusted. For the BWES extraction system, it may be necessary to check and adjust the air pressure at each pump and even the pump position (depth) within the sump to get the desired flowrate and drawdown. No other operation is required for normal operation of extraction trenches.

### **5.3.2. Extraction Pumps**

- Check and clean internal components of the flow meters quarterly to remove any solids that may have accumulated.
- Verify pump operation daily by observing flow rate at the flow meters (FM-802 and FM-803) in the influent manifold.
- Periodically adjust the pump flowrate to the desired level at the influent manifold by adjusting the appropriate valves on the pump discharge pipe.
- Periodically check flow meters (FM-802/FM-803) and the flow totalizer on the PLC.
- Check and clean the extraction pumps to remove any scale and solids that may have accumulated when the flow decreases substantially or the current draw increase.

The pumps and the extraction systems are to be periodically checked for water quantity, pressure, drawdown, periods of cycling, and operations of control. The extraction pumps may cycle on and off if the following conditions occur:

- If the water level in any extraction trench drops below the low-level switch setting on the pump, the extraction pump will shut off. If the water level rises to the high-level switch setting in a well operating in AUTO mode, the extraction pump will restart.

- If the water level in the influent equalization tank T-1 rises to the high-level alarm setting, all of the extraction well pumps will shut off. If the water level then drops below the low-level setting, the extraction well pumps will restart automatically.
- If the PGCS treatment facility triggers a flood alarm, all extraction well pumps will shut off. Manual restart of the extraction system is required after the flood condition has been rectified.

## **5.4 SHUT-DOWN PROCEDURES**

### **5.4.1. PGCS Extraction Pumps**

- Turn the HOA switch to OFF.
- Turn OFF the power supply.
- After the pump is stopped, close valve (V-01) on the pump discharge pipe.
- Once water in the manifold pipe has drained to influent equalization tank (T-2), close the tank influent valve.
- Turn off flow meter (FM-802) to prevent damage if water drains from the header piping to the pump sump.
- For an extended shut down, disconnect discharge piping to the pump, remove and clean the pump, and store in a dry, clean place per the manufacturer's recommendation.

### **5.4.2. BWES Extraction Pumps**

- After the pump is stopped, close valve (V-01) on the pump discharge pipe.
- Once water in the manifold pipe has drained to influent equalization tank (T-1), close the tank influent valve.
- Turn off flow meter (FM-803) to prevent damage if water drains from the header piping to the pump sump.
- For an extended shut down, disconnect discharge piping to the pump, remove and clean the pump, and store in a dry, clean place per the manufacturer's recommendation.



## **5.5 BASIC TROUBLE-SHOOTING PROCEDURES**

Table 5-1 outlines the basic trouble shooting to be encountered during the day-to-day operations of the PGCS extraction facility. Equipment manufacturer's literature (Volume 5) should be consulted for a step-by-step guide to equipment trouble shooting and repairs.

## **5.6 PREVENTIVE MAINTENANCE**

The PGCS facility maintenance program is described in Section 9.0 of this manual. Equipment manufacturer's literature should be consulted for equipment maintenance procedures and frequency. The following equipment requires preventive maintenance:

- Pneumatic pumps
- Electric submersible pumps.

TABLE 5-1

## TROUBLESHOOTING PGCS/BWES EXTRACTION SYSTEMS

Problem	Probable Cause	Corrective Action
<b>PGCS Extraction Pumps</b>		
No Flow to PGCS Facility	<ul style="list-style-type: none"> <li>• Low-level switch set too high</li> <li>• High-level switch set too low</li> <li>• Pump discharge valve closed</li> <li>• No power to the pump</li> <li>• Leak within the pump vault</li> <li>• Low water table in the extraction trench</li> <li>• Pump burn out</li> </ul>	<ul style="list-style-type: none"> <li>• Lower the low-level switch</li> <li>• Raise the high-level switch</li> <li>• Open pump discharge valve</li> <li>• Check power switch at the local control panel</li> <li>• Check pipe connections for leaks; rectify as required</li> <li>• Check water level in the corresponding piezometer; reduce pump cycle time as required</li> <li>• Replace pump</li> </ul>
Excess Flow to PGCS Facility	<ul style="list-style-type: none"> <li>• Low-level switch set too low</li> <li>• High-level switch set too low</li> <li>• Pump discharge valve open too far</li> <li>• High water table in the extraction trench</li> </ul>	<ul style="list-style-type: none"> <li>• Raise the low-level switch</li> <li>• Raise the high-level switch</li> <li>• Throttle back the pump discharge valve</li> <li>• Check water level in the corresponding piezometer; increase pump cycle time as required</li> </ul>
<b>BWES Extraction Pumps</b>		
Low Flow to PGCS Facility	<ul style="list-style-type: none"> <li>• Low-level switch set too high</li> <li>• High-level switch set too low</li> <li>• Pump discharge valve closed</li> <li>• Low setting on the air compressor</li> <li>• Low settings on the air regulator inside the pump vault</li> <li>• Excess pressure drop at the air filter</li> <li>• Leak within the pump vault</li> <li>• Low water table in the extraction trench</li> </ul>	<ul style="list-style-type: none"> <li>• Lower the low-level switch</li> <li>• Raise the high-level switch</li> <li>• Open pump discharge valve</li> <li>• Raise the compressed air settings on the air compressor</li> <li>• Raise the compressed air settings on the air regulator inside the pump vault</li> <li>• Replace the air filter inside the pump vault</li> <li>• Check pipe connections for leaks; rectify as required</li> <li>• Check water level in the corresponding piezometer; reduce pump cycle time as required</li> </ul>
Excess Flow to PGCS Facility	<ul style="list-style-type: none"> <li>• Low-level switch set too low</li> <li>• High-level switch set too low</li> <li>• Pump discharge valve open too far</li> <li>• High water table in the extraction trench</li> <li>• High setting on the air compressor</li> <li>• High settings on the air regulator inside the pump vault</li> </ul>	<ul style="list-style-type: none"> <li>• Raise the low-level switch</li> <li>• Raise the high-level switch</li> <li>• Throttle back the pump discharge valve</li> <li>• Check water level in the corresponding piezometer; increase pump cycle time as required</li> <li>• Lower the compressed air settings on the air compressor</li> <li>• Lower the compressed air settings on the air regulator inside the pump vault</li> </ul>

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## Section 6

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## **6.0 PRETREATMENT FACILITIES STARTUP AND OPERATION**

This section summarizes the startup procedures, O&M requirements, and trouble shooting of the PGCS pre-treatment facilities. The detailed operating procedures are described in Volumes 5 through 8 - Equipment Manufacturer's Manuals. These manuals include step-by-step procedures for startup, routine operations, shut down, and maintenance for each pretreatment process component.

The critical component of the pretreatment facility is the phase separator. The phase separator is designed to remove the majority of the NAPL from groundwater. NAPL can interfere with and overload the performance of the main treatment facility. It is, therefore, essential that NAPL separation by the phase separator is effective and that all groundwater streams containing even trace amount of NAPL be diverted to this pretreatment system. Refer to as-builts drawings (Drawing M-4 in Volume 4 of the O&M Manual) for locating various valves described in this section.

### **6.1 STARTUP**

These startup procedures are for initial operation with groundwater and assume that the system has been previously tested for leaks and equipment operation with clean water.

#### **6.1.1. Phase Separator (ME-1)**

At the initial startup, fill the phase separator with clean water and perform the following procedures:

- Verify that valves V-02 and V-05 are closed.
- Verify that valves (BWES influent valves are V-01, V-03, and V-07) are open.
- Verify that influent valve V-26 to the pretreatment equalization tank (T-1) is open.
- Verify that the extraction pumps are set for normal operations.

- Verify the position of all valves for initial startup per the equipment manufacturer's recommendation.
- Verify that the air vent to the process air collection system is functional.
- Verify that the vent on the phase separator is functional.
- Verify that vapor-phase GAC is on-line and operational. Note that this GAC unit may be taken off-line after initial operation period of approximately one year.
- Perform additional startup checks per the equipment manufacturer's recommendation.
- Turn on the extraction pump at the PGCS trench to begin pumping of groundwater to the treatment facility.
- Once water begins flowing through the phase separator, adjust the treated water overflow weir to the desired level.

#### **6.1.2. Pre-Treatment Equalization Tank (T-1)**

- Open the influent valve V-26.
- Verify that the tank vacuum release valve is operating smoothly.
- Inspect the tank for leaks in the piping connection and fittings.
- Turn ON the mixer ME-15. Adjust the mixer speed to the desired setting.

#### **6.1.3. Oil/LNAPL Storage Tank (T-6)**

- Open the influent valve V-119. Close effluent valve (V-10).
- Clean water and inspect the tank for leaks in the piping connection and fittings.

### **6.2 NORMAL OPERATIONS**

#### **6.2.1. Phase Separator (ME-1)**

- Periodically check the effluent weir depth and adjust as necessary.
- Periodically check the oil-water interface depth in the separator. Adjust the plate pack height accordingly.

- Periodically check the sludge depth inside the phase separator. It is recommended that the sludge removal pump P-12 be operated manually. However, a preset pump run timer is available on the MMI (Man Machine Interface) screen and can be used to set the time interval of operation once frequency of pumping has been established.
- On a quarterly basis, drain the tank and manually flush out solid deposits from the plate pack and at the bottom of the phase separator.
- Conduct equipment inspection, process control, and routine maintenance per the equipment manufacturer's recommendations.
- Complete the operator checklist and record all data required on the operation logs.

#### **6.2.2. Pre-Treatment Equalization Tank (T-1)**

- Check the tank and piping for leaks.
- Inspect and maintain mixer ME-15 according to the manufacturers instructions.

#### **6.2.3. Oil/LNAPL Storage Tank (T-6)**

- Check the tank and piping for leaks.
- Check oil/LNAPL level in the storage tank.
- To remove accumulated Oil/NAPL from the tank open valve V-09 and V-10.

### **6.3 SHUT-DOWN PROCEDURES**

#### **6.3.1. Phase Separator (ME-1)**

- If shut-down is for an extended period of time, shut-down the extraction pumps and close all influent valves (V-01B, V-02, V-03, V-06, and V-07).
- Remove NAPL and sludge from storage tanks by manually activating the sludge pump (P-12).
- Manually flush out solids from the plate pack and drain the separator completely.
- Close effluent valves (V-109A and V-109B).

- Open electrical circuit breakers at panel to discontinue electrical power to the air compressor unit motor and the pretreatment process components.

### **6.3.2. Pre-Treatment Equalization Tank (T-1)**

- Close valves on piping entering the tank (V-26, V-27 and V-30).
- Turn off mixer ME-15.

### **6.3.3. Oil/LNAP Storage Tank (T-6)**

- Close valves on piping entering the tank (V-119).

## **6.4 TROUBLE SHOOTING**

Table 6-1 outlines the basic trouble shooting that may be required during the day-to-day operations of the PGCS pretreatment process components. Equipment manufacturer's literature (Volume 5) should be consulted for a step-by-step guide to equipment trouble shooting and repairs.

## **6.5 PREVENTIVE MAINTENANCE**

The PGCS facility maintenance program is described in Section 9.0 of this manual. Equipment manufacturer's literature should be consulted for equipment maintenance procedures and frequency. The following equipment requires preventive maintenance:

- Phase separator (ME-1)
- Mixer (ME-15)



TABLE 6-1

## TROUBLESHOOTING PRETREATMENT FACILITIES

Problem	Probable Cause	Corrective Action
<b>Phase Separator</b>		
Reduced Effluent Quality	<ul style="list-style-type: none"> <li>• Increase in system flow rate</li> <li>• Excess oil level over separator pack</li> </ul>	<ul style="list-style-type: none"> <li>• Check influent flow rate; adjust the effluent weir to accept higher flow rate or adjust extraction flow rate</li> <li>• Adjust separator pack depth to allow the oil to drain adequately</li> </ul>
Low solids content in sludge stream	<ul style="list-style-type: none"> <li>• Sludge pumped too often</li> </ul>	<ul style="list-style-type: none"> <li>• Increase time period between successive pumping of phase separator sludge</li> </ul>
<b>Pretreatment Equalization Tank</b>		
Level Alarm Condition	<ul style="list-style-type: none"> <li>• Influent pump setting too high</li> <li>• Pretreatment pump setting too low</li> <li>• Pretreatment pump failure</li> <li>• False signal from level probe</li> </ul>	<ul style="list-style-type: none"> <li>• Throttle back the influent pump valve</li> <li>• Adjust throttle valves on pretreatment pumps</li> <li>• Replace pretreatment pump</li> <li>• Clean the probe; check for output signal</li> </ul>
Mixer Failure	<ul style="list-style-type: none"> <li>• No power to the mixer</li> <li>• Mixer turned OFF</li> <li>• Mixer motor burn out</li> </ul>	<ul style="list-style-type: none"> <li>• Check power connection to the mixer</li> <li>• Check switch setting on the mixer; turn the mixer ON if in the OFF position</li> <li>• Replace the mixer</li> </ul>
<b>Oil/LNAPL Storage Tank</b>		
Level Alarm Condition	<ul style="list-style-type: none"> <li>• Tank full</li> <li>• False signal from level probe</li> </ul>	<ul style="list-style-type: none"> <li>• Drain tank using valve V-10.</li> <li>• Clean the probe; check for output signal</li> </ul>

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## **Section 7**

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## **7.0 MAIN TREATMENT FACILITIES STARTUP AND OPERATION**

This section summarizes the startup procedures, O&M requirements, and trouble shooting of the PGCS main treatment facilities. The detailed operating procedures are described in Volumes 5 through 8 - Equipment Manufacturer's Manuals. These manuals include step-by-step procedures for startup, routine operations, shut downs, and maintenance for each treatment process component.

The UV oxidation system is the main treatment unit for organic removal while the chemical precipitation and solids separation units serve as the primary system for metals and suspended solids removal. The success of the PGCS depends on effective operation of UV oxidation system and the chemical precipitation solids separation units. It is, therefore, critical to carefully adjust the UV oxidation system and the chemical precipitation solids separation units during the startup phase. Refer to the as-builts drawings (Volume 4 of the O&M Manual) for various valve locations.

### **7.1 STARTUP**

These startup procedures are for initial operation with groundwater and assume that the system has been previously tested for leaks and equipment operation with clean water.

#### **7.1.1. Main Equalization Tank (T-2)**

- As the tank is filling, verify that the level probe indicates the correct fluid level.
- Inspect the tank for leaks in the piping connection and fittings.
- Turn ON the mixer (ME-16).

#### **7.1.2. Influent Pumps (P-3, P-4, and P-5)**

- Check pump lubrication, alignment, and rotation.
- Check the sample port to ensure that the sample valve (V-47) is closed.

- Open all valves in the suction lines (V-36, V-39 and V-42) and discharge lines (V-38, V-41, V-44, V-45, and V-47).
- Set the HOA switch for pumps to AUTO at the MCP.
- Verify that pump operation corresponds to the level or flow setting.
- Verify auto shutoff at low-level in the main equalization tank (T-2) and auto start at high level in the tank.
- Check for unusual noise, vibrations, overheating, and leakage.

### **7.1.3. Chemical Feed System**

The individual components of the chemical feed systems are lumped together and considered as parts of a single unit. The entire chemical feed system should be checked, started, brought on line at the same time. This method ensures integrity of the feed system as a complete unit and also allows for timely startup of the down-stream treatment process that depend on the chemical feed system for an effective treatment.

- Verify that stock solutions are available in tanks (T-7, T-8, T-9).
- Verify that foot valves and the 4-function valves for the chemical pumps are in correct position.
- Verify that air release valves (V-113 and V-115) on the hydrogen peroxide solution feed line operate smooth.
- Open valves in the suction lines (V-106, V-108, V-110, V-112, V-114, V-116, V-118 and V-120).
- Open valves in the discharge lines (V-107, V-109, V-111, V-113, V-115, V-117, V-119 and V-121).
- Verify individual pumps (P-16 through P-25) for are primed.
- Set electrical connections to ON at the pump local control panel.
- Set stroke length and frequency for each pump.
- Check for unusual noise, vibrations, overheating, and leakage.

### **7.1.4. UV Oxidation System (ME-2)**

The steps presented here provide an outline of the startup procedure for the UV Oxidation System. Refer to the manufacturer's information for a detailed startup (Volume 5 - Equipment Manufacturer's Manuals). The operator should be familiar with the step-by-

step procedure for the UV Oxidation System startup prior to placing the system into operation.

- Open influent valve (V-45) and effluent valve (V-48).
- Close bypass valve (V-49), and sample port valve (V-47).
- Verify that the peroxide, acid, and catalyst feed systems are on line, fully functional, and are in AUTO position. Open the required suction and discharge valves at the chemical metering pump. Adjust the chemical pumps to the desired feed rate.
- Check the pH probe and chemical feed ports to ensure that the probe and chemical feed lines are secured.
- While in operation, conduct the manufacture recommended monitoring during startup.
- Follow manufacturer's instructions for startup procedures. Note that the start button on the UV oxidation unit energizes the whole treatment plant for entire treatment plant startup in auto mode.

#### **7.1.5. Chemical Precipitation Unit**

The steps presented here provide an outline of the startup procedures for the chemical precipitation unit (rapid mix, flocculator, clarifier). Refer to the manufacturer's literature in Volumes 5 through 8 of this manual for a detailed startup of the unit.

- Close bypass valve (V-51) and the unit drain valves.
- Verify that the chemical feed system is operational and is set to AUTO mode.
- Verify that the polyblend system (ME-23) is operational and set to AUTO.
- Calibrate the pH control system and enter the control setpoints on the PLC.
- Confirm that plant air supply is available at the sludge pump (P-13) and that the air pressure and pump cycle time are adjusted to the desired values.
- Set the electrical connections to ON and control switches to AUTO.
- Follow the manufacturer's instruction for startup of the unit and the various components, including the mixers and pumps.
- Ensure that mixers (ME-17, ME-18 and ME-19) are operating properly.
- While in operation, conduct the manufacturer recommended monitoring for startup.

#### **7.1.6. Upflow Sand Filter (ME-7)**

- Open influent valve (V-57) and effluent valve (V-59).
- Close bypass valve (V-58).
- Confirm that plant air supply is available at the filter control panel.
- Turn the power ON at the filter control panel.
- Follow the manufacturer's instructions for startup of the filter unit.
- Adjust the air flowrate and reject water weir height to ensure that the sand is being adequately washed and that reject water is not able to short circuit into the filter effluent. To ensure that reject water is not able to short circuit into the effluent, the water level (thus, the weir) in the sand washer should be maintained at a slightly lower elevation (1/4 to 1/2 inches) than the water in the filter unit itself.
- Perform system monitoring according to the manufacturer's instructions.

#### **7.1.7. pH Adjustment Tank (T-3)**

- Close the tank drain valve(s).
- Calibrate the pH monitoring system and enter the setpoints on the PLC.
- Open the primary influent fill valve from the upflow sand filter (ME-7).
- Verify that the chemical feed system is operational and is set to AUTO mode.
- Set the mixer control switch to AUTO.
- Verify the pH control on the PLC.

#### **7.1.8. Effluent Pumps (P-6, P-7 and P-8)**

- Check pump lubrication, alignment, and rotation.
- Close the sample port valve (V-102).
- Verify that check valves (V-61, V-65, and V-67) on the discharge lines seat completely.
- Open all valves in the suction lines (V-60, V-63 and V-66) and discharge lines (V-62, V-64, and V-66).
- Verify that the flow meter (FE/FIT-801) is on line and operational.
- Set electrical connections to ON at the MCC.

- Set the HOA switch for pumps to AUTO at the MCP.
- Verify that pump operation corresponds to the level setting.
- Verify auto shutoff at low-level in the main equalization tank (T-3) and auto start at high level in the tank.
- Check for unusual noise, vibrations, overheating, and leakage.
- Verify flow meter (FE/FIT-801) and totalizer reading on the PLC.

#### **7.1.9. GAC Contactors (ME-8 and ME-9)**

- Refer to the manufacturers instructions for initial conditioning and backwashing of the activated carbon with tap water.
- Determine the lead and lag units for operation in series.
- Open the GAC effluent valves for lead/lag operation.
- Close GAC backwash valves.
- Open discharge valve (V-87) and close the sample port valve (V-102).
- Open the GAC influent valves for lead/lag operation.
- Follow the manufacturer's instructions for startup of GAC units.
- While in operation, perform system monitoring per manufacturer's instructions.

#### **7.1.10. Effluent pH and Flow Control**

- Verify that the chemical feed system is operational and is set to AUTO mode.
- Verify power to the magnetic flow meter (FE/FIT-801).
- Verify the pH control on the PLC.
- Verify flow rate on the PLC.

#### **7.1.11. Sludge Dewatering**

The sludge dewatering operation is manually controlled from the local control panel on JWI's filter press. Refer to the manufacturers' information for detailed startup procedure.

#### **7.1.11.1. Sludge Storage & Thickening Tank (T-5)**

- Close the tank outlet valve (V-20) and the sample port V-23.
- Close all valves on the tank decant discharge lines (V-16 through V-21) except when decanting liquid above the settled sludge.
- Set the mixer control switch to AUTO.
- Check for leaks in the tank, piping, and fittings.
- Confirm that the plant air supply to the air diaphragm pumps and the filter press are ON, and the pressure setting at the desired value.
- Verify that adequate sludge is available in the Sludge Storage/Thickening Tank to fill the filter press with a full load of sludge. Open sludge outlet valve V-22.
- Follow manufacturer's instructions for actual startup of the sludge dewatering system.
- Sludge pump P-14 is controlled and interlocked with the filter press PLC.

#### **7.1.11.2. Filter Press (ME-12)**

- Confirm that the plant air supply to sludge pump (P-14) and the filter press is on, and pressure settings are at the desired values.
- Verify that adequate sludge is available in tank (T-5).
- Verify that the polymer system is operational and set to AUTO.
- Confirm roll-off dumpster (ME-14) is in position under the filter press.
- Follow manufacturer's instructions for actual startup of the filter press.

#### **7.1.11.3. Sludge/Scum Pumps (P-12, P-13, P-14 and P-15)**

- Confirm that the plant air supply to sludge pumps (P-12, P-13 and P-14) is on, and pressure settings are at the desired values.
- Verify that adequate sludge is available in T-5, ME-1, or ME-6.
- Confirm operation of air solenoid valves (V-103, V-105 and V-126).
- Verify that check valves (V-11, V-55, and V-21) seat completely.
- Open the appropriate influent valves to individual sludge pumps (V-10, V-53, V-15).
- Open the appropriate effluent valves (V-12, V-56 or V-22).



## **7.2 NORMAL OPERATIONS**

Once the system is fully on line and operating at the desired flow rate, the treatment facilities will be operate by themselves based on the vendor PLCs and other instrumentation. The system design incorporates complete automation (except for filter press start operation) of the facility components; operator attention has been minimized. However, the operator has to conduct routine and preventive maintenance to avoid break downs in the treatment system; perform process monitoring as specified in this document, other project-specific documents or the manufacturer's information; and complete operational logs for record keeping and documentation.

### **7.2.1. Main Equalization Tank (T-2)**

- Check the tank and piping for leaks.
- Check mixer for lubrication, noise, vibration, alignment and shaft motion.

### **7.2.2. Influent Pumps (P-3, P-4 and P-5)**

- Check pumps for lubrication, alignment, and rotation.
- Check for unusual noise, vibrations, overheating, and leakage.
- Check motor for operating temperature and shaft motion.

### **7.2.3. Chemical Feed System**

- Check the tanks and piping for leaks.
- Verify that chemical solutions are available. If needed, prepare fresh stock.
- Verify that the plant air is available and is set to the desired pressure value.
- Check pumps for unusual noise, vibrations, overheating, and leakage.
- Check pump motors for operating temperature.

### **7.2.4. UV Oxidation System (ME-2)**

- Refer to manufacturer's literature for regular operations and maintenance.
- Check the PLC for AUTO operations.

- Check and maintain UV lamps. Replace UV lamps if required. Follow manufacturer's instructions for UV lamp replacement.
- Verify that chemical solutions are available. If needed, prepare fresh stock.
- Verify that the chemical feed pumps are in AUTO position.
- Verify calibration of pH probe.
- Perform process monitoring as specified.
- Ensure that the UV oxidation control panel is safe to operate and there are no leaks or water around the UV oxidation unit.

#### **7.2.5. Chemical Precipitation Unit**

- Refer to manufacturer's literature for regular operations and maintenance.
- Inspect the overall system for leaks and general integrity.
- Verify that the PLC is operating in AUTO mode.
- Verify operation of all pumps, mixers and pH probes.
- Verify that chemical solutions are available. When needed, order fresh stock.
- Periodically check the pH probe and chemical feed ports to ensure that the probe and the chemical feed lines are secure.
- Perform process monitoring as specified.
- Adjust the sludge pump cycle frequency and pumping rate as necessary.

#### **7.2.6. Upflow Sand Filter (ME-7)**

- Check the backwash flow rate and visually observe sand output of the airlift pump.
- Perform process monitoring as specified.
- Verify compressed air supply is on and the rotameter and pressure regulator are operational.

#### **7.2.7. pH Adjustment Tank (T-3)**

- Check the tank and piping for leaks.
- Check level indicators for proper operation.
- Verify that chemical solutions are available. When needed, order fresh stock.
- Verify that the chemical feed pumps are in AUTO position.

- Periodically check the pH probe and chemical feed ports to ensure that the probe and the chemical feed lines are secure.
- Check mixer for lubrication, noise, vibration, alignment and shaft motion.
- Verify operation and calibration of pH probes on a periodic basis.
- Verify pH control on the PLC.

#### **7.2.8. Effluent Pumps (P-6, P-7 and P-8)**

- Check pumps for lubrication, alignment, and rotation.
- Check for unusual noise, vibrations, overheating, and leakage.
- Check motor for operating temperature and shaft motion.

#### **7.2.9. GAC Contactors (ME-8 and ME-9)**

- Identify the lead and lag contactor units during current operation.
- Verify that all valves are set as described in the startup procedures.
- Verify pressure gauges on each unit are operational. If the differential pressure across either the lead or lag unit exceeds 10 psi, perform backwash procedures as specified by the manufacturers instructions.
- Perform routine process monitoring procedures as specified. If the lead unit shows poor performance, perform GAC replacement per manufacturer's instructions.

#### **7.2.10. Effluent pH and Flow Control**

- Verify that adequate chemical solutions are available. Order fresh stock as needed.
- Verify that the chemical feed pumps are in AUTO position.
- Collect samples for on-site or laboratory analyses at the specified frequency.
- Calibrate pH probe and flow meter on a regular basis.
- Monitor pH and flow at the control panel.
- If effluent does not meet regulatory requirements, transfer off-spec effluent to the Tank T-4. Ensure that the inlet valves to the Tank T-4 are open before transferring the off-spec effluent.
- Prepare operations log and other documents per the regulatory requirements.

#### **7.2.11. Sludge Storage & Thickening Tank (T-5)**

- Confirm that level indicators in sludge storage tanks are calibrated.
- Adjust position of decant valves as necessary to decant liquid from the top of settled sludge.
- Check for leaks in the tank, piping, and fittings.

#### **7.2.12. Filter Press (ME-12)**

- Clean equipment and general area.
- Perform maintenance on the sludge pumps.
- Perform dewatering procedures as required.
- Perform process monitoring procedures as specified.
- Coordinate sludge transport to off-site disposal facility.

### **7.3 SHUT-DOWN PROCEDURES**

#### **7.3.1. Main Equalization Tank (T-2)**

- Close fill valves to the tank.
- Shut off the chemical feed system and turn mixer OFF.

#### **7.3.2. Influent Pumps (P-3, P-4 and P-5)**

- Shut off the pump by turning the respective control switch at the MCP to OFF or by selecting Off in the computer control system when the control switch on the MCP is in the AUTO position.
- Check the motor for shaft motion.
- Close all valves on the influent and effluent lines.
- Turn off flow meter on the pump discharge line to prevent back flow damage.

#### **7.3.3. Chemical Feed System**

- Shut the pump OFF at the local control panel.

- Check the motor for shaft motion.
- Close all valves on the influent and effluent lines.

#### **7.3.4. UV Oxidation System (ME-2)**

- Close influent valve to the oxidation system.
- Shut off the chemical feed systems.
- Follow manufacturer's instructions for the oxidation unit shut off.
- Confirm the power supply to the UV oxidation unit is shut-off at the main breaker panel.

#### **7.3.5. Chemical Precipitation Unit**

- Close influent valve to the Flash Mix/Floc Tank.
- Shut off the chemical feed system and turn the control switches for the mixers to the OFF position.
- Remove and clean the pH probe and store in clean storage solution if the shut down is for more than a few days.
- Check the sludge thickener tank; pump to sludge storage tank (T-5) if necessary.
- Leave water in the Lamella unit.

#### **7.3.6. Upflow Sand Filter (ME-7)**

- Turn off the backwash air at the filter control panel
- Close influent and effluent valves.

#### **7.3.7. pH Adjustment Tank (T-3)**

- Close fill valves to the tank.
- Shut off the chemical feed system and turn mixer control switch to the OFF position.
- Remove and clean the pH probe and store in clean storage solution if the shut down is for more than a few days.

### **7.3.8. Effluent Pumps (P-6, P-7 and P-8)**

- Shut off the pumps by turning the respective control switch at the MCP to OFF or by selecting Off in the computer control system when the control switch on the MCP is in the AUTO position.
- Check the motor for shaft motion.
- Close all valves on the influent and effluent lines.
- Turn off flow meter on the pump discharge line to prevent back flow damage.

### **7.3.9. GAC Contactors (ME-8 and ME-9)**

- For normal shut down of one GAC unit, close inlet and discharge valves on the GAC unit taken off service and verify that flow-through the off service unit has completely ceased (by observing the pressure gauge).
- For the GAC system shut down, close all inlet and discharge valves on both units; however, keep contactors full of water to prevent corrosion.
- For replacement of spent carbon, follow the procedures for shut down of one GAC unit. The follow manufacturer's instructions for carbon replacement.

### **7.3.10. Effluent pH and Flow Control**

- Close the effluent discharge valve.
- Shut OFF the chemical feed pumps to storage tanks and filter press.
- Turn the flow meter OFF.
- Remove and clean the pH probe and store in clean storage solution if the shut down is for more than a few days.

### **7.3.11. Sludge Storage & Thickening Tank (T-5)**

- Turn off the sludge transfer pump(s) (P-12, P-13) to the sludge storage tank by selecting OFF on the HOA switch on the LCP.
- Close inlet valves to the storage tank.
- Dewater contents of the tank and close the tank outlet valve.

### **7.3.12. Filter Press (ME-12)**

- Accelerated sludge handling may be required prior to an extended shut down.
- Turn OFF the mixer at the local panel and at the MCC.
- Shut OFF the chemical feed pumps to storage tanks and filter press.
- Follow manufacturer's instructions for the filter press shut off.

## **7.4 TROUBLE SHOOTING**

Table 7-1 outlines the basic trouble shooting that may be required during the day-to-day operations of the PGCS facility. Equipment manufacturer's literature (Volumes 5 through 8) should be consulted for a step-by-step guide to equipment trouble shooting and repairs.

## **7.5 PREVENTIVE MAINTENANCE**

The PGCS facility maintenance program is described in Section 9.0 of this manual. Equipment manufacturer's literature should be consulted for equipment maintenance procedures and frequency. The following equipment requires preventive maintenance:

- Influent Pumps
- Chemical Metering Pumps
- In-line and Tank Mixers
- UV Oxidation Unit
- Chemical Precipitation Unit
- Upflow Sand Filter
- Effluent Pumps
- GAC Contactors
- Filter Press
- Sludge/Scum Pumps
- Air Solenoid Valves

TABLE 7-1

**TROUBLESHOOTING MAIN TREATMENT FACILITIES**  
Page 1 of 6

Problem	Probable Cause	Corrective Action
<b>Main Equalization Tank, pH Adjustment Tank, and Sludge Storage and Thickening Tank</b>		
Level Alarm Condition	<ul style="list-style-type: none"> <li>• Influent pump setting too high</li> <li>• Effluent pump setting too low</li> <li>• Effluent pump failure</li> <li>• False signal from level probe</li> </ul>	<ul style="list-style-type: none"> <li>• Throttle back the influent pump valve</li> <li>• Open the effluent pump valve a quarter turn</li> <li>• Replace effluent pump</li> <li>• Clean the probe; check for output signal</li> </ul>
Mixer Failure	<ul style="list-style-type: none"> <li>• No power to the mixer</li> <li>• Mixer turned OFF</li> <li>• Mixer motor burn out</li> </ul>	<ul style="list-style-type: none"> <li>• Check power connection to the mixer</li> <li>• Check switch setting on the mixer; turn the mixer ON if in the OFF position</li> <li>• Replace the mixer motor</li> </ul>
<b>Influent Pumps, Filtrate/Decant Sump Pumps, Effluent Pumps</b>		
Shut Down	<ul style="list-style-type: none"> <li>• Low level in the pump influent tank</li> <li>• Pump motor burn out in one pump.</li> </ul>	<ul style="list-style-type: none"> <li>• Check the pump influent tank for proper operation</li> <li>• Replace the pump</li> </ul>
High Pressure Shut Down	<ul style="list-style-type: none"> <li>• Discharge line valve closed</li> </ul>	<ul style="list-style-type: none"> <li>• Trace discharge line and open all valves. Reset pump(s) to the ON position at MCC.</li> </ul>



TABLE 7-1

# TROUBLESHOOTING MAIN TREATMENT FACILITIES Page 2 of 6

Problem	Probable Cause	Corrective Action
Pump running excessive hours due to little or no liquid discharge	<ul style="list-style-type: none"> <li>Discharge valve closed</li> <li>Air-locked pump</li> </ul>	<ul style="list-style-type: none"> <li>Open discharge valve completely</li> <li>Allow the water level to rise in the influent tank and cycle the pump manually</li> <li>Remove and repair - there is probably debris in the impeller. <u>Lock out power before working on pumps.</u> Check pump operation before putting back on service.</li> </ul>
	<ul style="list-style-type: none"> <li>Pump locked up</li> <li>Non-functioning check valve</li> <li>Piping or valve plugged</li> </ul>	<ul style="list-style-type: none"> <li>Verify pump and check valve functioning first.</li> <li>Disassemble the check valve to see if they are closing and opening completely.</li> <li>Attempt to backflush the line with another pump. "Snake" or disassemble line or valves, if necessary.</li> </ul>
Insufficient Discharge Pressure	<ul style="list-style-type: none"> <li>Causes listed above</li> <li>Pump motor is "single phasing"</li> <li>Pump impeller worn out or damaged</li> </ul>	<ul style="list-style-type: none"> <li>See solutions above</li> <li>Electrician to check the amperage draw and resistance of the motor power lines. Replace electric lines or refurbish pump as necessary.</li> <li>Inspect impeller. Replace if worn or excessively damaged.</li> </ul>

TABLE 7-1

## TROUBLESHOOTING MAIN TREATMENT FACILITIES

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Problem	Probable Cause	Corrective Action
Motor Overload - motor winding temperature switch tripped	<ul style="list-style-type: none"> <li>• Specific gravity or viscosity of the liquid is too high.</li> <li>• Pump impeller defective</li> <li>• Clogged pump, line, or valving</li> <li>• Defective bearings</li> <li>• Damaged motor</li> <li>• Faulty control box component</li> </ul>	<ul style="list-style-type: none"> <li>• There may be excessive solids or grit in the tank. Inspect the tank and remove these offending materials. Also check for operational problems in the up-stream processes.</li> <li>• Inspect and replace, if necessary</li> <li>• See section for "Pump Running Excessive Hours"</li> <li>• Remove pump and check for noisy or hot operations. Service the pump, if necessary.</li> <li>• Electrician should check the winding resistance. It should not be "0".</li> <li>• Electrician should check the motor controls. Repair as necessary.</li> </ul>
Pump does not Cycle Properly	<ul style="list-style-type: none"> <li>• Faulty switch</li> <li>• Clogged pump, line, or valve</li> <li>• Motor damaged</li> <li>• Controls damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Operate pumps on HAND while floats are removed for work</li> <li>• See section for "Pump Running Excessive Hours"</li> <li>• See section for "Motor Overload"</li> <li>• Electrician should inspect and repair the controls</li> </ul>
Pump Excessively Noisy	<ul style="list-style-type: none"> <li>• Worn out bearing</li> <li>• Imbalanced pump</li> <li>• Broken impeller</li> <li>• Bent motor shaft</li> </ul>	<ul style="list-style-type: none"> <li>• Remove the pump, disassemble, and repair</li> <li>• Bearing failure may be imminent, or already have occurred. Debris on impeller. Clear impeller</li> <li>• Remove and replace</li> <li>• Disassemble pump and repair</li> </ul>
Chemical Feed System Pump Shut Off	<ul style="list-style-type: none"> <li>• Feed tank level low</li> <li>• Foot valve suction out of solution</li> </ul>	<ul style="list-style-type: none"> <li>• Replenish chemical stock solution</li> <li>• Lower the foot valve suction</li> </ul>
High Pressure Shut Off	<ul style="list-style-type: none"> <li>• Closed valve on the discharge line</li> </ul>	<ul style="list-style-type: none"> <li>• Trace discharge line and open all valves</li> </ul>

TABLE 7-1

## TROUBLESHOOTING MAIN TREATMENT FACILITIES

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Problem	Probable Cause	Corrective Action
<b>UV Oxidation System - See Manufacturer's Equipment Catalog</b>		
<b>Chemical Precipitation Unit</b>		
Haze in Effluent or Floc Carry-Over	<ul style="list-style-type: none"> <li>• Fouling of plates</li> <li>• High sludge inventory</li> <li>• Increase in Flow Rate</li> <li>• Too much hydrogen peroxide</li> </ul>	<ul style="list-style-type: none"> <li>• Clean plates</li> <li>• Check sludge level in thickener and increase blow-down frequency</li> <li>• Increase blow-down frequency OR decrease flow rate</li> <li>• Adjust peroxide dose in UV oxidation system or add sodium bisulfate to system influent</li> </ul>
Oil/Grease in Tank	<ul style="list-style-type: none"> <li>• NAPL in influent</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor feed stream and correct operations at phase separator</li> </ul>
Flow Surges	<ul style="list-style-type: none"> <li>• Wrong adjustment of influent valving or feed stream rate</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor feed stream and adjust</li> </ul>
Unequal Distribution of Precipitate or Poor Solids Separation	<ul style="list-style-type: none"> <li>• Wrong adjustment or dislocation of plates</li> <li>• High or low influent flow to Lamella</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor and adjust</li> <li>• Monitor feed stream and adjust</li> </ul>
High Color in Effluent	<ul style="list-style-type: none"> <li>• Wrong adjustment of chemical feeds</li> <li>• Fouling of plates</li> <li>• High sludge inventory</li> <li>• Ineffective operation at UV oxidation unit</li> </ul>	<ul style="list-style-type: none"> <li>• Check and adjust</li> <li>• Clean plates</li> <li>• Increase blow-down frequency</li> <li>• Adjust operation according to manufacturer's equipment instructions</li> </ul>

TABLE 7-1

**TROUBLESHOOTING MAIN TREATMENT FACILITIES**  
Page 5 of 6

Problem	Probable Cause	Corrective Action
Plates Touching or Binding	<ul style="list-style-type: none"> <li>• Plate flexing</li> <li>• Uneven or excessive flow rate</li> </ul>	<ul style="list-style-type: none"> <li>• Check plate mounting and repair according to manufacturer's recommendations</li> <li>• Monitor and adjust</li> </ul>
<b>Upflow Sand Filter</b>	See manufacturer's O&M Manual Troubleshooting guide.	
Low Flow Rate	<ul style="list-style-type: none"> <li>• Discharge valve partially closed</li> <li>• Excessive head loss</li> </ul>	<ul style="list-style-type: none"> <li>• Check discharge valve and adjust flow as needed</li> <li>• Check manufacturer's literature for automatic backwash operation correction</li> </ul>
High Head Loss (> 10 psi)	<ul style="list-style-type: none"> <li>• Poor influent water quality</li> <li>• Growth and accumulation of micro organisms</li> <li>• Dirty filter</li> </ul>	<ul style="list-style-type: none"> <li>• Check up-stream treatment processes for operational problems</li> <li>• Check chemical feed system for operational problems OR make operational corrections</li> <li>• Increase backwash flow rate</li> </ul>
Poor Effluent Quality	<ul style="list-style-type: none"> <li>• Flow surges through plant</li> <li>• Dirty filter</li> </ul>	<ul style="list-style-type: none"> <li>• Return flow to steady state</li> <li>• Increase backwash flowrate</li> </ul>
No Backwash Flow Rate	<ul style="list-style-type: none"> <li>• Backwash pump failure</li> </ul>	<ul style="list-style-type: none"> <li>• Restart pump and check air supply</li> </ul>
<b>GAC Contactors</b>		
Low Flow	<ul style="list-style-type: none"> <li>• Discharge valve partially closed</li> <li>• Excessive head loss</li> <li>• Valve positioned incorrectly</li> </ul>	<ul style="list-style-type: none"> <li>• Check discharge valve and adjust flow as needed</li> <li>• Backwash contactor</li> <li>• Take contactor off line until incoming flow to the system maintains desired flow rate</li> </ul>

TABLE 7-1

# TROUBLESHOOTING MAIN TREATMENT FACILITIES Page 6 of 6

Problem	Probable Cause	Corrective Action
High Head Loss (> 15 psi)	<ul style="list-style-type: none"> <li>Poor influent water quality</li> <li>Growth and accumulation of biological solids in contactor</li> <li>Carbon deterioration during handling and large amounts of carbon fines accumulating</li> <li>Distribution header plugged</li> </ul>	<ul style="list-style-type: none"> <li>Check filtration process for operational problems</li> <li>Backwash filter</li> <li>Backwash carbon and wash fines from system OR replace carbon with harder grade of carbon</li> <li>Reverse flow for 1 - 2 minutes to remove fines and replace on line</li> </ul>
Poor Effluent Quality	<ul style="list-style-type: none"> <li>Carbon is exhausted as evidenced by high contaminant concentration in the lead unit</li> <li>Carbon fines in the effluent</li> </ul>	<ul style="list-style-type: none"> <li>Replace carbon in the lead contactor</li> <li>Run effluent to waste until fines are removed</li> </ul>
<b>Effluent pH and Flow Control</b>		
No Flow	<ul style="list-style-type: none"> <li>Closed valve upstream</li> <li>Bypass valve open</li> </ul>	<ul style="list-style-type: none"> <li>Trace process lines and open appropriate valves</li> <li>Close bypass valve(s)</li> </ul>
pH Out of Range	<ul style="list-style-type: none"> <li>Chemical feed tank level low</li> <li>Foot valve suction out of solution</li> <li>Chemical feed pump malfunction</li> <li>pH probe malfunction</li> </ul>	<ul style="list-style-type: none"> <li>Replenish chemical stock solution</li> <li>Lower the foot valve suction</li> <li>Calibrate pH probe</li> <li>Check chemical feed pump and feed line</li> </ul>
<b>Filter Press - See Manufacturer's Equipment Catalog</b>		
<b>Sludge/Scum Pumps</b>		
No sludge flow	<ul style="list-style-type: none"> <li>Refer to probable causes listed under other types of pumps</li> <li>No/insufficient air pressure</li> </ul>	<ul style="list-style-type: none"> <li>Refer to corrective actions listed under other types of pumps</li> <li>Take air pressure readings at the air compressor control panel. Adjust as needed.</li> </ul>

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## **Section 8**

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**MONTGOMERY WATSON**

## **8.0 FACILITY SUPPORT SYSTEMS STARTUP AND OPERATIONS**

This section summarizes the startup procedures, O&M requirements, and trouble shooting of the PGCS support systems. The detailed operating procedures are described in Volumes 5 through 8 - Equipment Manufacturer's Manuals. These manuals include step-by-step procedures during startup, routine operations, shut down, and maintenance for each pretreatment process component.

The critical component of the treatment system support systems is the air compressor. Operation of several components of the PGCS facility depend on proper operation of the air compressor.

### **8.1 STARTUP**

The PGCS facility support systems are to be checked independently of the treatment system prior to introducing water to the treatment facility.

#### **8.1.1. Air Collection System**

- Verify that there are no leaks in the collection piping.
- Confirm that all vent valves on the process tanks are functional and seat smoothly.

#### **8.1.2. Air Treatment System**

- Verify that the inlet and discharge valves are in OPEN position and a carbon canister is attached to the air discharge line.

#### **8.1.3. Compressed Air System**

- Verify that valve settings of the air compressor system are per manufacturer's specifications and the valves in the compressed air lines are set for proper delivery of air to the treatment system components.

- Verify that the air dryer is on line and that all filter housing are secure.
- Turn the air compressor control switches at the MCC to AUTO.
- Turn the individual compressor units local control switches to ON.
- Follow the manufacturer's instructions for actual startup of compressor and air dryer.
- Verify that the system operates properly and no unusual noises or air leaks are detected.
- Adjust the air pressure settings at compressor and air receiver as required.

#### **8.1.4. Facility Water**

- Verify that the inlet valve is open.

Note: Water pressure to the PG CS treatment facility is low, use of tap water may cause some components (i.e., polyblend unit) of the treatment facility to shutdown due to low water pressure thus causing the shutdown of the entire treatment process. It may be necessary to install a booster pump on the facility line to increase the water pressure if shutdowns become a problem.

### **8.2 NORMAL OPERATIONS**

Once is system is fully on line and operating, the support systems will be operate by themselves based on the vendor PLCs and other instrumentation. However, the operator has to conduct routine and preventive maintenance to avoid break downs in the treatment system; perform process monitoring as specified in this document, other project-specific documents or the manufacturer's information; and complete operational logs for record keeping and documentation.

#### **8.2.1. Air Collection System**

Same as the startup procedures.

#### **8.2.2. Air Treatment System**

- Visually inspect integrity of collection piping.
- Perform routine process monitoring procedures as specified.



- If the treatment unit shows poor performance, replace carbon canister.

### **8.2.3. Compressed Air System**

- Check, clean and replace air filters as necessary.
- Perform inspection and maintenance procedures on the compressors, dryers, and receivers as required by the equipment manufacturers.
- Verify pressure at the compressor, receiver, and local gauges on a periodic basis.

### **8.2.4. Facility Water**

- Verify that the inlet valve is open and there are no visual leaks/drips on the main water feed line or at the backflow preventor.

## **8.3 SHUT-DOWN PROCEDURES**

### **8.3.1. Foul Air Treatment System**

- Manually shut down the inlet and discharge valves. Verify that the flow has stopped through the GAC unit.

### **8.3.2. Compressed Air System**

- Shut down air compressors locally. Turn control switch to the OFF position.
- Turn air compressor switches at MCC to OFF.
- Bleed air from receiver and air lines.

## **8.4. TROUBLE SHOOTING**

Equipment manufacturer's literature (Volumes 5 through 8) should be consulted for a step-by-step guide to equipment trouble shooting and repairs.

## **8.5 PREVENTIVE MAINTENANCE**

The PGCS facility maintenance program is described in Section 9.0 of this manual. Equipment manufacturer's literature should be consulted for equipment maintenance procedures and frequency.

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## **Section 9**

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**MONTGOMERY WATSON**

## **9.0 MAINTENANCE PROGRAM**

The PGCS treatment facility is designed for fully automatic operations; full time operator attendance may not be required in the long term. However, the groundwater extraction, treatment, and discharge systems do require scheduled maintenance and monitoring. Maintenance should be conducted promptly in order to prevent emergency occurrences at the facility.

There are three factors which must be considered in the field maintenance: design, construction, and operation. Facility design was established in such a manner that effective maintenance can be performed. Facility construction includes a thorough inspection program (construction management) to minimize the risk of faulty materials or equipment in the PGCS system. Facility operation must carry out the actual maintenance procedures to ensure that the plant routinely meets the purpose of its design in an efficient and safe manner.

### **9.1 MAINTENANCE CATEGORIES**

Maintenance performed at the facility can be categorized into four general classifications described below.

#### **9.1.1. Spare Parts Management**

Each major piece of equipment at the facility is provided with critical spare parts to accommodate for emergency repairs. Table 9-1 provides an inventory of recommended spare parts and is based on the equipment manufacturer's recommendation.

The facility staff should maintain an inventory list for the required spare parts and update the inventory when spare parts are used during maintenance. The facility staff should inform the plant superintendent of the spare parts restocking requirements for maintaining a full inventory.

When establishing the initial spare parts list, the superintendent should assemble inventory for special tools to ensure the proper tools are used when performing the required maintenance procedures.

**TABLE 9-1**  
**RECOMMENDED SPARE PARTS LIST**

<b>Equipment</b>	<b>Spare Part/Item</b>	<b>Quantity</b>
PGCS Extraction Pumps	Pumps and motors	1
BWES Extraction Pumps	Pumps	1
PGCS Influent Manifold Piping	Flow meter	1
Influent/Effluent Feed Pumps	Pump and motor	1
Chemical Feed System	Chemical metering pump	1
UV Oxidation System	UV lamp	1
Chemical Precipitation Unit		
Upflow Sand Filter	O-rings, air lift pump chamber	1
	O-rings, air lift inlet nut	1
	Screen, air lift pump	1
	Regulator, instrument air	1
	Air flow indicator	1
pH Adjustment Tank	pH probe electrode	1
GAC Contactor		
Filter Press	Filter cloth	1 set
	Gasket material	100 feet
	Air filter element	1
	Oil filter element	1
	Muffler element	1
Sludge/Scum Pumps	Diaphragms	2
	Air solenoid valve	1
	Ball check valves	1 set
Effluent pH and Flow Control	pH probe electrode	1
Compressed Air System	Air filter elements	1/filter
	Pump oiler oil	0.5 gallon

### **9.1.2. Preventive Maintenance**

Preventive maintenance is the most crucial program to ensure proper, long-term operation of the system components. It involves service maintenance tasks to prevent or minimize process shut down, to reduce wear on all equipment, and to extend the useful life of equipment and structures.

Preventive maintenance requirements for primary equipment are listed on Table 9-2. Refer to equipment manufacturer's literature for further details. All maintenance should be conducted by trained and authorized personnel and in accordance with the equipment manufacturer's recommendations..

### **9.1.3. Routine Maintenance**

Routine maintenance (or facility housekeeping) involves the care of the facility building as well as the mechanical equipment. Routine maintenance of the mechanical equipment should be conducted as needed or as specified by the equipment manufacturer.

Walkways and stairways within the facility should be kept clear of debris and hosed down periodically for reasons of health and safety. The laboratory, office, instrumentation room, mechanical room, and other work areas should be cleaned regularly and kept in good order.

### **9.1.4. Corrective Maintenance**

Corrective maintenance is all work required to repair major equipment malfunctions including complete overhauls and emergency repairs. Maintenance personnel should be prepared to handle this type of emergency work at all times to ensure continuity of the facility operation.

A major item of concern with the execution of corrective maintenance is that these maintenance tasks are generally more complex, thereby requiring more expertise and mechanical aptitude to complete the job. The Superintendent must determine if the work needed to be done can be accomplished by in-house personnel or must be contracted out to a specialized service contractor.

**TABLE 9-2**  
**PERIODIC MAINTENANCE REQUIREMENTS FOR**  
**PRIMARY EQUIPMENT**

<b>Equipment/Process</b>	<b>Maintenance Items</b>	<b>Frequency</b>
1. PLC/MCP	<ul style="list-style-type: none"> <li>• Check screens and alarm data</li> <li>• Check setpoints, flow and pH data</li> <li>• Backup and print data</li> </ul>	daily daily monthly
2. Extraction Wells Pumps	<ul style="list-style-type: none"> <li>• Remove, disassemble and clean pumps</li> <li>• Clean and rehabilitate sumps</li> </ul>	quarterly or as necessary annually
3. Influent Manifold	<ul style="list-style-type: none"> <li>• Clean internals of flowmeters</li> <li>• Exercise manifold valves</li> </ul>	quarterly or as necessary weekly
4. UV Oxidation System	<ul style="list-style-type: none"> <li>• Clean and calibrate pH probe</li> <li>• Exercise all valves</li> <li>• Check and clean chemical feed pump</li> </ul>	weekly weekly monthly
5. Chemical Feed System	<ul style="list-style-type: none"> <li>• Check for unusual pump vibration</li> <li>• Check for motor overheating</li> <li>• Exercise all valves</li> </ul>	weekly weekly weekly
6. Influent Pumps	<ul style="list-style-type: none"> <li>• Check for unusual pump vibration</li> <li>• Check for motor for overheating</li> <li>• Check lubricant levels</li> <li>• Exercise all valves</li> <li>• Check and clean flowmeter</li> </ul>	weekly weekly weekly weekly monthly
7. Equalization Tanks	<ul style="list-style-type: none"> <li>• Check, clean and calibrate level sensors</li> <li>• Check mixer lubrication</li> <li>• Check mixer motor for overheating</li> <li>• Check mixer for vibration</li> <li>• Replace gear oil</li> </ul>	monthly monthly monthly weekly annually

TABLE 9-2

# **PERIODIC MAINTENANCE REQUIREMENTS FOR PRIMARY EQUIPMENT**

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Equipment/Process	Maintenance Items	Frequency
8. pH Adjustment System	<ul style="list-style-type: none"> <li>• Check, clean and calibrate pH probe</li> <li>• Check and clean chemical feed pump</li> <li>• Check mixer lubrication</li> <li>• Check mixer motor for overheating</li> <li>• Check mixer for vibration</li> <li>• Replace gear oil</li> </ul>	<p>weekly</p> <p>monthly</p> <p>monthly</p> <p>monthly</p> <p>weekly</p> <p>annually</p>
9. Chemical Precipitation	<ul style="list-style-type: none"> <li>• Check, clean and calibrate pH probe</li> <li>• Check and clean chemical feed pump</li> <li>• Check mixer lubrication</li> <li>• Check mixer motors for overheating</li> <li>• Check mixers for vibration</li> <li>• Check flocculator speed</li> <li>• Clean clarifier orifices and weirs</li> <li>• Check and clean clarifier plates</li> <li>• Check and adjust sludge pump</li> <li>• Replace gear oil</li> <li>• Tighten bolts and touch up paint</li> </ul>	<p>daily</p> <p>monthly</p> <p>weekly</p> <p>weekly</p> <p>weekly</p> <p>weekly</p> <p>weekly</p> <p>quarterly</p> <p>weekly</p> <p>annually</p> <p>annually</p>
10. Upflow Sand Filter	<ul style="list-style-type: none"> <li>• Check and adjust backwash air flow</li> <li>• Check air filter</li> <li>• Check headloss</li> <li>• Remove and inspect air lift</li> </ul>	<p>weekly</p> <p>monthly</p> <p>daily</p> <p>annually</p>
11. Effluent Pumps	<ul style="list-style-type: none"> <li>• Check for unusual pump vibration</li> <li>• Check for motor for overheating</li> <li>• Check lubricant levels</li> <li>• Exercise all valves</li> </ul>	<p>weekly</p> <p>weekly</p> <p>quarterly</p> <p>weekly</p>
12. GAC Contactors	<ul style="list-style-type: none"> <li>• Check GAC backpressure</li> <li>• Backwash carbon</li> <li>• Replace carbon</li> <li>• Exercise valves</li> </ul>	<p>daily</p> <p>as needed</p> <p>as needed</p> <p>weekly</p>



**TABLE 9-2**  
**PERIODIC MAINTENANCE REQUIREMENTS FOR**  
**PRIMARY EQUIPMENT**  
Page 3 of 3

Equipment/Process	Maintenance Items	Frequency
13. Effluent Monitoring	<ul style="list-style-type: none"> <li>• Check, clean and calibrate pH probe</li> <li>• Check and clean flow meter</li> </ul>	weekly monthly
14. Filter Press	<ul style="list-style-type: none"> <li>• Check filter cloth</li> <li>• Wash filter cloth</li> <li>• Check plumbing</li> <li>• Check hydraulic oil level</li> <li>• Check hydraulic oil filter</li> <li>• Replace oil and filter</li> <li>• Grease fittings</li> </ul>	each cycle as needed weekly weekly monthly yearly quarterly
15. Sump Pumps	<ul style="list-style-type: none"> <li>• Check for unusual pump vibration</li> <li>• Check for motor for overheating</li> <li>• Check lubricant levels</li> <li>• Exercise all valves</li> <li>• Check and clean basket strainer</li> </ul>	weekly weekly quarterly weekly weekly
16. Compressed Air System	<ul style="list-style-type: none"> <li>• Check all particulate and condensate filters</li> <li>• Check for unusual compressor vibration</li> <li>• Check and lubricate motor</li> </ul>	monthly weekly quarterly

## **9.2 GENERAL MAINTENANCE CONDITIONS**

All maintenance requires considerable skill acquired by experience, study, and practice. All maintenance programs should incorporate a good housekeeping program and should serve the following rules:

- Keep a clean, neat, and orderly operating facility
- Establish a systematic plan for the execution of regular operations
- Establish a routine schedule for inspections and lubrications
- Keep data and records of each piece of equipment, with emphasis on unusual incidents and faulty operating conditions.

Performance of the day-to-day maintenance functions is only one obligation of maintenance personnel. There is the obligation of record keeping on each individual piece of equipment, to include all work performed on that particular unit, along with comments on the overall condition and operating characteristics. Analysis of these records assists in the detection of an impending failure of the piece of equipment and subsequent scheduling of its repair in a timely manner.

### **9.2.1. Observation of Field Safety**

Each operator should be aware of the dangers and restrictions involved when performing maintenance on any piece of equipment. Employees can be injured on the job from the misuse of tools, lifting heavy objects incorrectly, and/or handling chemical without taking necessary precautions.

## **9.3 PLANNING AND SCHEDULING**

A key to properly maintaining facility operation is detailed planning and scheduling of maintenance functions to be performed. Planning and scheduling should consider tasks to be performed, time required, personnel skills, special tools or equipment required, work order lead times, availability of parts, environmental factors, parts reorder lead

times, equipment replacement schedules, vacations, holidays, and availability of personnel. Scheduling charts with priorities of subjects, personnel, and time should be used as a planning tool so as to maximize resources and personnel and to help minimize idle time and wasted effort. Those tasks to be performed at a specified interval such as daily, weekly, or monthly, may be grouped accordingly for work scheduling purposes.

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## **Section 10**

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**MONTGOMERY WATSON**

## 10.0 MONITORING, RECORDKEEPING, AND REPORTING

This section describes the compliance and process monitoring to be conducted for the PGCS and the BWES. It also provides guidelines to be followed for recordkeeping and reporting of operational and analytical data for the facilities.

### 10.1 COMPLIANCE MONITORING

Compliance monitoring must be conducted for both the PGCS and BWES to ensure that the facilities are successfully meeting their intended objectives. Compliance monitoring will also aid in optimizing operation of the groundwater treatment system to ensure continued compliance with the discharge permit requirements.

Compliance monitoring for the PGCS will be conducted per the *PGCS Performance Standard Verification Plan* and *Quality Assurance Project Plan* which are included in Volume 2.0 of the *PGCS/BWES O&M Manual*. The PGCS compliance monitoring activities include:

- Collecting treatment system effluent samples at a gradually decreasing frequency
- Taking water level measurements at a gradually decreasing frequency
- Monitoring the off-gas vent (influent and effluent from vapor phase carbon) for 8 weeks including collection of 2 ambient air samples

Compliance monitoring for the BWES will be conducted per the *BWES Performance Standard Verification Plan* and the *Quality Assurance Project Plan* which are included in Volume 2.0 of the *PGCS/BWES O&M Manual*. The BWES compliance monitoring activities include:

- Taking water level measurements at a gradually decreasing frequency
- Collecting pump discharge data monthly

- Instantaneous flow rate and total volume of water from the combined BWES extraction system
- Conducting pump test on each extraction trench within the barrier wall.

## **10.2 PROCESS MONITORING**

Monitoring the treatment system is an important aspect of process optimization, determining treatment efficiency, and troubleshooting problems. This section identifies the significant process monitoring parameters for the different treatment processes. Table 10-1 provides a summary of the process monitoring including the types of analysis, sampling frequency and locations, and the number of samples for each unit process.

### **10.2.1. PGCS Extraction System**

Monitoring the groundwater quality from each of the PGCS extraction trench legs is important to provide data regarding changes in contaminant concentrations in the areas affected by each of the legs. This information, in conjunction with the water level data and the quarterly groundwater monitoring program data, will be used to assess whether or not any of the extraction sumps can be turned off. This data will also be used to identify portions of the extraction trench that may have higher levels of certain parameters than other portions. For example, if the data show that the groundwater from extraction sump EW-19 has a relatively high COD but very low levels of the contaminants, it may be desirable to throttle that extraction system back to a lower flowrate. This situation may actually occur since EW-19 pulls groundwater from the wetlands areas where there is likely to be high levels of natural organic material (which could cause a high COD). The high COD of the groundwater will impact the cost of operating the treatment system.

The following parameters should be monitored in conjunction with the quarterly monitoring program:

- Benzene, toluene, ethylbenzene, and total xylenes (BTEX)
- COD
- TSS
- Iron

**TABLE 10-1**  
**PROCESS MONITORING REQUIREMENTS FOR THE PGCS AND BWES**

Sampling Point	Parameters	Frequency	No. of Samples Per Year	Recommendations for On-Site or Off-Site Analysis
PGCS Extraction Sump 1	BTEX	Quarterly	4	Off-Site
	COD	Quarterly	4	On-Site
	TSS	Quarterly	4	On-Site
	Iron	Quarterly	4	On-Site
PGCS Extraction Sump 2	BTEX	Quarterly	4	Off-Site
	COD	Quarterly	4	On-Site
	TSS	Quarterly	4	On-Site
	Iron	Quarterly	4	On-Site
PGCS Extraction Sump 3	BTEX	Quarterly	4	Off-Site
	COD	Quarterly	4	On-Site
	TSS	Quarterly	4	On-Site
	Iron	Quarterly	4	On-Site
Combined PGCS Extraction System	Flow	Continuous	--	--
	COD	Quarterly	4	On-Site
	VOCs	Annually	1	Off-Site
	SVOCs	Annually	1	Off-Site
	PCBs	Annually	1	Off-Site
	Metals	Annually	1	Off-Site
	Genl Minls	Annually	1	Off-Site
BWES Extraction Sump 1 through Extraction Sump 9	BTEX	Quarterly	36	Off-Site
	COD	Quarterly	36	On-Site
	TSS	Quarterly	36	On-Site
	Iron	Quarterly	36	On-Site
Combined BWES Extraction System	Flow	Continuous	--	--
	COD	Quarterly	4	On-Site
	VOCs	Annually	1	Off-Site
	SVOCs	Annually	1	Off-Site
	PCBs	Annually	1	Off-Site
	Metals	Annually	1	Off-Site
	Genl Minls	Annually	1	Off-Site
Phase Separator Influent	Oil & Grease	Quarterly	4	Off-Site
Phase Separator Effluent	Oil & Grease	Quarterly	4	Off-Site
	Free Oil	Weekly	52	On-Site
Oil Storage	Volume	Weekly	--	--

COD      Chemical Oxygen Demand  
Genl Minls    General water quality parameters including iron

**TABLE 10-1**  
**PROCESS MONITORING REQUIREMENTS FOR THE PGCS AND BWES**  
**(CONTINUED)**

Sampling Point	Parameters	Frequency	No. of Samples Per Year	Recommendations for On-Site or Off-Site Analysis
Oxidation System Influent	Flow	Continuous	--	--
	pH	Continuous	--	--
	COD	Weekly	52	On-Site
	BTEX	Weekly	52	Off-Site
	TSS	Weekly	52	On-Site
	Iron	Monthly	12	On-Site
	VOCs	Monthly	12	Off-Site
	SVOCs	Monthly	12	Off-Site
	Metals	Monthly	12	Off-Site
	PCBs and PCP	Monthly	12	Off-Site
Oxidation System Effluent	Genl Minls	Quarterly	4	Off-Site
	COD	Weekly	52	On-Site
	TSS	Monthly	12	On-Site
	Iron	Monthly	12	On-Site
	Residual Peroxide	Weekly	52	On-Site
	VOCs	Monthly	12	Off-Site
	SVOCs	Monthly	12	Off-Site
	Metals	Monthly	12	Off-Site
	PCBs and PCP	Monthly	12	Off-Site
Precipitation System Effluent	pH	Continuous	--	--
	TSS	Weekly	52	On-Site
Precipitation System Sludge	TSS	Monthly	12	On-Site
Sand Filter Effluent	TSS	Weekly	52	On-Site
	Metals	Monthly	12	Off-Site
	VOCs	Quarterly	4	Off-Site
pH Adjustment Tank	pH	Continuous	--	--
Lead GAC Effluent	VOCs	Quarterly	4	Off-Site
Lead GAC Effluent	SVOCs	Quarterly	4	Off-Site
Lag GAC Effluent	VOCs	[This is covered by the compliance monitoring]		
Lag GAC Effluent	SVOCs	[This is covered by the compliance monitoring]		
Effluent	Flow	Continuous	--	--
	pH	Continuous	--	--
Sludge Tank	TS	Weekly	52	On-Site
Filter Cake	TS	Per Batch	52	On-Site

COD      Chemical Oxygen Demand

Genl Minls    General water quality parameters including iron



BTEX is listed as a monitoring requirement because benzene is the primary contaminant in the groundwater near the PGCS extraction system. COD is needed to monitor the performance of and to make adjustments to the UV oxidation unit. TSS and iron are listed as monitoring requirements because both of these can cause problems for the flowmeters, pH probes, UV oxidation unit, and other process units. Consequently, it is essential to have an understanding of the levels of these constituents. The combined flow stream from the three trench legs in the PGCS extraction system should also be monitored to provide information regarding changes or trends in the quality of the groundwater. This information will be used to make adjustments to the treatment system. The combined stream should be analyzed at least annually for the full range of parameters shown in Table 10-1 and at least quarterly for COD. Combined flow from the PGCS extraction trench will be automatically recorded by the control system and should be periodically checked by the operator.

#### **10.2.2. BWES Extraction System**

Similar to the PGCS extraction system, the BWES extraction trenches should be monitored periodically to provide information on what constituents and contaminants are coming from each trench. This is particularly crucial for the BWES trenches because it is anticipated that groundwater in some of the areas will have very high levels of contamination and the respective extraction pumps may need to be throttled back by raising the pump or reducing the air supply pressure. Even if the initial sampling indicates that groundwater from a certain trench is fairly clean, the quality may change significantly as the area is dewatered and groundwater from the waste areas migrates toward the trenches. The recommended analyses and frequency are shown in Table 10-1 for individual trenches and the combined stream. Combined flow from the BWES extraction system will be automatically recorded by the control system and should be periodically checked by the operator.

#### **10.2.3. Phase Separator**

The main purpose of the phase separator is to remove the floating free oil and grease (O&G) and suspended solids from the PGCS influent thereby preventing shock loading or over loading of the main treatment components including the UV oxidation system. As such, samples should be collected from the phase separator influent and effluent on a

quarterly basis and analyzed for O&G. Free oil present in the phase separator overflow should be monitored every week to provide a general information on the units performance. The free oil measurement can be made by collecting a sample of the phase separator effluent and letting it set for about 1 hour. The sample should ideally be collected in a 1-liter graduated cylinder. After the 1 hour settling period, the volume of any oil layer should be noted and recorded. If free oil is accumulating in the sample, it is a sign that the unit is overloaded, the overflow weir needs to be adjusted, or perhaps the valve on the oil discharge line is closed.

Skimmed oil and grease and other floating material will flow by gravity to the oil storage tank. The oil storage tank should be checked on a weekly basis and the volume of oil should be recorded.

#### **10.2.4. UV Oxidation System**

The UV oxidation system serves as the main treatment component for destruction of organic components in the groundwater. The objective of the UV oxidation system is to treat organic contaminants to the discharge criteria. The influent flow to the UV oxidation system and pH of the influent stream will be monitored continuously using an in-line flow meter and pH probe. In addition, it is essential to have data on the constituents in the combined (PGCS and BWES) influent to the UV oxidation system. As shown in Table 10-1 it is recommended that COD, BTEX, and TSS be measured weekly, and that iron, VOCs, SVOCs, PCBs, PCP, and metals be measured monthly on the combined influent. An analysis of general minerals should be conducted quarterly. If the data show that PCBs and PCP are not present in the influent, the sampling frequency for these constituents can be reduced to quarterly or perhaps annually. This data is essential for identifying trends in the groundwater quality, for determining the appropriate chemical feed rates, and for determining operational relationships such as the ratio of required peroxide dose to influent COD.

Since the UV oxidation unit is the main treatment process, the effluent from the unit should be measured for COD on a weekly basis to provide a general indicator of the unit's performance. Residual peroxide should also be measured weekly using the peroxide strips. Table 10-2 describes the testing which should be conducted to determine the minimum acceptable residual peroxide dose. This is an important value to determine

TABLE 10-2

## DETERMINATION OF ACCEPTABLE RESIDUAL PEROXIDE

Estimated Peroxide Dose	Measured Peroxide Dose in Influent	Measured Residual Peroxide in Effluent	Influent COD	Effluent COD	Effluent VOCs*	Effluent SVOCs*
500 ppm						
300ppm						
200ppm						
100ppm						
50ppm						

When setting the metering pump to the desired peroxide feed dose, remember to account for the fact that the peroxide is a 50% solution, not pure hydrogen peroxide.

- Need to compare individual VOCs and SVOCs concentrations in the UV/Ox effluent to the discharge standards. If they exceed their respective discharge standards, then the peroxide feed dose and residual dose are not acceptable.

since too much peroxide will cause solids floating problems in the clarifier and too little peroxide will cause reduced performance of the oxidation unit. The effluent from the oxidation unit should be measured monthly for TSS, iron, VOCs, SVOCs, PCBs, PCP, and metals. All of this data will be used to evaluate the performance of the treatment unit and to identify potential causes of performance problems. As stated previously, the UV oxidation unit is the main treatment process and it is intended that the effluent from this unit will meet the discharge criteria for all organics. Consequently, the monitoring around this process unit is more intensive.

The operators should also be aware that the presence of residual peroxide in samples collected after the UV oxidation unit can affect the analytical results. Attachment A to this section presents the procedures to be used to minimize the effects of the residual peroxide. The protocol should be used on any sample collected for the specific analyses where the residual peroxide level is above 5 mg/l.

#### **10.2.5. Precipitation System**

This system is the primary treatment for removal of iron and other metals such as lead, zinc, nickel, copper, chromium, and for precipitation of the suspended solids. The precipitation of iron at high pH requires pH monitoring in the flocculation tank. The total suspended solids concentration in the precipitation system influent and the effluent provide an indication of overall efficiency of the precipitation system for solids removal and allow estimation of the amount of sludge produced by the system. As shown in Table 10-1, it is recommended that the precipitation system effluent be measured for TSS once a week. The influent to the precipitation system is the same as the UV oxidation unit effluent which is essentially the same as the UV oxidation unit influent (the TSS is not expected to change through the UV oxidation unit). Therefore, influent TSS data will be collected weekly as well.

#### **10.2.6. Sand Filter**

In the sand filter, process efficiency is determined by suspended solids removal. Total suspended solids should be analyzed in the sand filter effluent on a weekly basis. Results from the sand filter effluent will be compared with the precipitation system effluent (which is the sand filter influent) to calculate the filtration efficiency.

Metals concentrations in the sand filter effluent should be analyzed monthly to provide data regarding the overall removal efficiency of the precipitation unit/sand filter for removal of these constituents. In addition, it is recommended that VOCs be sampled and analyzed on a quarterly basis to provide information regarding organics that may have passed through the UV oxidation unit and could potentially pass through the GAC units.

#### **10.2.7. pH Adjustment Tank**

Effluent from the sand filter requires pH adjustment to meet the effluent discharge criteria. pH will be recorded continuously by the control system and adjusted automatically to be within the desired pH range (6 to 9 units).

#### **10.2.8. Carbon Adsorption System**

The carbon adsorption system serves as a final polishing unit for removal of organic contaminants from the groundwater stream. (Some inorganics will also be removed by the carbon.) The GAC contactors are operated in series which is referred to as lead-lag operation. When operated in this manner, the first or lead carbon unit removes the contaminants and the second or lag carbon unit serves as a backup. When the carbon in the lead unit becomes saturated with contaminants, breakthrough of contaminants occurs and the lag unit begins to remove contaminants. At this time, the lead unit should be taken off-line and the saturated carbon should be replaced with new carbon. The valving is then switched so that the groundwater flows through previous lag unit first, thus making that unit the new lead unit. The previous lead unit then becomes the new lag unit. The units are rotated in this manner so that uncontaminated carbon is always present in the lag unit thus providing backup. This mode of operation also allows for the lead unit to be used for a longer period of time which reduces carbon cost.

In order to detect breakthrough of contaminants from the lead carbon unit, it is necessary to routinely sample the effluent from that unit. The effluent from the lag unit should also be sampled and analyzed to assure that no contaminants are passing through, but the effluent compliance samples required in the PGCS PSVP will provide this data. As shown in Table 10-1, it is recommended that the effluent from the lead unit be measured quarterly for VOCs and SVOCs. This frequency will likely need to change based on operator experience and the quality of the influent. For instance:

- During initial startup or if the influent characteristics change (such as when the BWES trenches come on-line), it will be necessary to sample more frequently in order to determine how long it takes contaminants to breakthrough the lead carbon unit. If, for example, the data show that breakthrough occurs after 4 months of operation at a flowrate of 40 gpm, then the sampling frequency should be changed to monthly after the first three months of operation.
- If the influent groundwater contains organic contaminants that are not effectively removed by the UV oxidation unit, it may be necessary to increase the frequency of sampling around the carbon units.
- If the carbon is not needed and not on-line, no samples will be collected.

The operators should work closely with the engineering staff to determine the appropriate sampling frequency for the carbon units.

#### **10.2.9. Effluent Flow and pH Measurement**

Treated effluent from the GAC contactors flows through the effluent pH meter and effluent flow meter and then to the three subsurface discharge structures. Effluent not meeting the pH discharge standards is recycled to the equalization tank for additional treatment. Effluent flow and pH are automatically recorded by the control system and should be periodically checked by the operator. Effluent quality must be monitored in accordance with the PGCS PSVP.

#### **10.2.10. Sludge Storage and Thickening**

This system provides storage, thickening and dewatering of recovered suspended solids and process sludge precipitated from the groundwater. To determine the efficiency of the dewatering process, the sludge in the sludge storage tank and the sludge cake from the filter press should be analyzed for total solids.

### **10.3 OPERATION AND MAINTENANCE RECORDS**

Establishing and maintaining a complete facility records system is vital to an efficient operation and maintenance of the treatment facility. Proper record keeping will fulfill the regulatory reporting requirements, create a baseline and criteria for the planning of facility expansions or continued operation, benefit performance evaluation and remedies to periodic treatment problems, and assist in estimating and scheduling maintenance activities and budgets. All required documentation must be kept at the on-site office and a copy of the records must be submitted to the engineering manager.

#### **10.3.1. Daily Activity Reports**

The details of daily operations are to be summarized and recorded using the daily activity report worksheets. The worksheet is used to record the time of the day, activities that took place, any sampling and analytical results, visual observations, and any calculations. The worksheets will also serve as a reminder of routine activities and inspections to be conducted at the treatment facility.

#### **10.3.2. Operation Log**

A bound diary or journal-type log book should be maintained by the operator for the extraction and treatment facilities. Typical instrument readings, startup or shutdown of equipment, occurrence of accidents, major breakdowns, commencement and completion of major maintenance efforts, chemical deliveries, changes in operation, and monitoring sampling should be included in the operation log. Log entries of various activities and problems should be made as they develop so that no items are overlooked.

#### **10.3.3. Summary Records**

A summary record is useful in identification of operational trends and forecasting of problems. For most operations, a monthly log arranged in the chronological order and showing equipment performance, chemical consumption, and other facility activities should be included in the summary records.

#### **10.3.4. Cost Records**

The maintenance of complete cost records is valuable for use in the budgeting and planning efforts. The costs should include utility usage, chemical and shipping costs, equipment rental, and usage costs. Records defining the allocations and costs of labor for the facility should also be maintained.

#### **10.3.5. Progress Reports**

Progress reports must be prepared to transfer operations information from the operators to the ACS Technical Committee and the engineering manager. The progress reports must be submitted to the engineering manager on a monthly basis along with any laboratory data reports.

#### **10.3.6. Compliance Monitoring Reports**

Compliance monitoring reports must be prepared and submitted to the regulatory agencies on a quarterly basis. In addition, all water level data, effluent sample data, and pump discharge data will be forwarded to the agencies on a monthly basis. The engineering manager or project manager will prepare and submit the quarterly reports, but the operators must provide the information required in accordance with the PGCS PSVP and the BWES PSVP along with the progress reports.

### **10.4 LABORATORY RECORDS**

Proper performance and interpretation of laboratory analyses will enable the operations staff to maximize efficiency and effectiveness of the various unit processes. Laboratory analyses are also performed to ascertain whether or not compliance with the discharge standards is being achieved; such results shall be reported to the EPA and the IDEM in accordance with the PSVPs and associated QAPPs.

The reporting program requires an adequate record keeping plan in order to maintain credibility. The following are recommended record keeping guidelines, to be exercised at the PGCS and BWES.



#### **10.4.1. Sample Logs**

Before any sample is collected, a significant amount of planning must be performed, as discussed earlier in this document. The tool utilized to structure this planning is a sample log. Through a sample log, the sample stream, size, collection time and method, mode of preservation, and analysis schedule can all be predetermined, and all quality assurance requirements can easily be fulfilled.

A sample log will be completed for each sample acquired at the extraction and treatment facilities with the following information written in indelible ink:

- Sample name and/or flow stream
- Exact location of sampling point
- Type of sample (grab or composite)
- Type of preservative, if applicable
- Date and time of collection
- Sampling location
- Analyte(s) or analytical method(s)
- Initials of sampling personnel.

#### **10.4.2. Chain-Of-Custody (COC)**

The chain-of-custody procedures allow for the tracing of possession and handling of individual samples from the time of field collection through laboratory analysis. Documentation of custody is accomplished through a COC record that lists each sample and the individuals responsible for sample collection, shipment, and receipt. A sample is considered in custody if it is:

- In a person's possession
- In view after being in physical possession
- Locked or sealed so that no one can tamper with it after having been in physical custody

- In a secured area, restricted to authorized personnel.

A COC form will be used to record the samples collected and the analyses requested. Information recorded will include time and date of sample collection, sample number, the type of sample, the sampler's signature, the required analysis, and the type of containers and preservatives used.

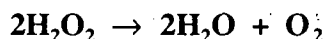
A copy of the COC record will be retained by the sampler prior to shipment. Shipping receipts will be signed and filed as evidence of custody transfer between field sampler and courier, and the courier and laboratory.

## ATTACHMENT A

### DESTRUCTION OF RESIDUAL PEROXIDE IN SAMPLES

If the residual peroxide from the UV oxidation system effluent is not removed, it will interfere with the COD and BOD measurements and it will degrade VOCs, SVOCs, PCBs, and PCP in the sample as they await analyses. Residual peroxide sampling and analysis will be conducted weekly. Table 10-2 presents the criteria for determination of an acceptable residual peroxide in the UV oxidation system effluent.

**Method:** This method involves the destruction of residual hydrogen peroxide in samples to be analyzed for COD, BOD, VOCs, SVOCs, PCBs, and PCP. The method uses the catalase enzyme to catalytically decompose peroxide to water and oxygen gas according to the following reaction:



To perform the destruction procedure, a catalytic amount of catalase is added to the sample and mixed until the residual peroxide is destroyed. The sample can then be analyzed for the respective parameter according to the methods listed in the PSVP and QAPP. In situations with low COD or where more accurate COD determinations are desired, a blank (catalase added to distilled water in the same proportion as in the actual samples) should be run along with the sample set so that the COD contribution of catalase can be determined and subtracted from the sample values.

**Reagents:** C-40 catalase (Bovine Liver obtained from Sigma Chemical [800-565-1400]). Dissolve 41.8 mg in 100 mL of distilled water to make a stock solution. Divide the stock into small aliquots (2 to 5 mL) and store in plastic vials in the freezer. Also store unused solid catalase powder from Sigma in the freezer.

#### Procedure:

1. Adjust the sample to within a pH range of 6.5 to 7.5 with acid or base depending on the starting pH. Record the acid or base dose (volume added) for each sample.
2. Remove a vial of catalase stock from the freezer and thaw. Note: unused catalase in the vial can be stored in the refrigerator and used for up to 8 hours. If the thawed catalase is "older" than 8 hours it should be discarded and a fresh vial should be thawed and used.
3. Add 100  $\mu\text{L}$  (0.1 mL) of the catalase stock solution from the vial to each 25 mL of sample. Mix the sample until the peroxide is destroyed (confirm destruction with a

peroxide test strip). For peroxide concentrations less than 100 mg/L, the destruction procedure should eliminate the peroxide in less than 15 minutes. If the peroxide concentrations are very high (>500 mg/L) then the destruction can take along time or be incomplete and second catalase addition may be necessary.

4. Prepare a blank by adding the amount of catalase added to the samples to an equivalent amount of distilled water.

Run the COD analysis on the samples and the blank. Subtract the COD value of the blank from the COD values of the samples. Adjust the COD value of each sample by the dilution factor from the pH adjustment step (1) if pH of the sample was adjusted.

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## Section 11

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MONTGOMERY WATSON



## **11.0 ALTERNATE OPERATION AND MAINTENANCE PROGRAM**

### **11.1 INTRODUCTION**

The treatment facility is equipped with a sophisticated instrumentation and control system which provides a high degree of automation while maintaining a safe operational environment. The treatment facility will be attended by an operator most of the time that the facility is operational. The facility design incorporates alarm signals to provide an advance notification to the operator of impending problems. In addition, a certain amount of redundancy is built into the treatment system design. However, a potential exists for a system failure which may threaten the release of hazardous substances, pollutants or contaminants to the atmosphere and endanger public health or the environment.

This section presents the potential failures that may occur in the treatment system, the impact of these failures on the facility operations, and the alternate operations/corrective actions to be implemented to provide continued treatment of extracted groundwater at the facility.

### **11.2 POTENTIAL SYSTEM FAILURE**

Potential system failure could occur due to malfunctioning of mechanical equipment or the control logic. Failure of any major equipment could lead to the facility shut down. Table 11-1 presents a vulnerability analysis of the treatment facility components and also identifies the impact of potential equipment failure on the facility operation.

### **11.3 ALTERNATE PROCEDURE**

The treatment facility design provides a high degree of flexibility in conducting alternate operation. For example, failure of the UV Oxidation system could lead to discharge of partially treated water that may exceed the performance standards. However, activated carbon vessels have been provided as a backup in case of poor performance or failure of the UV Oxidation system and to provide organic removal commensurate with the discharge standards. Similar redundancy exists for each major component of the treatment facility. Table 11-1 identifies alternate operations that can be conducted in the event of equipment failure. These alternate operations should provide continued

TABLE 11-1

## DESCRIPTION OF ALTERNATE OPERATION

Process Unit	Vulnerability Analysis and Impact	Alternate Operations/Corrective Action
PGCS Extraction Pumps	<ul style="list-style-type: none"> <li>Pump burn out or mechanical failure; inadequate containment of groundwater.</li> </ul>	<ul style="list-style-type: none"> <li>Increase pumping rate of two remaining pumps. Replace pump.</li> </ul>
BWES Extraction Pumps	<ul style="list-style-type: none"> <li>Air supply or pump malfunction; no groundwater extraction in that area.</li> </ul>	<ul style="list-style-type: none"> <li>No alternate operation. Replace pump.</li> </ul>
Phase Separator	<ul style="list-style-type: none"> <li>Inadequate oil removal; potential interference with the secondary treatment units.</li> </ul>	<ul style="list-style-type: none"> <li>Reduce or shut off flow from source area with high oil. Install a second phase separator.</li> </ul>
Oil/LNAPL Storage Tank	<ul style="list-style-type: none"> <li>Tank leak; spill of potentially hazardous materials within the facility.</li> </ul>	<ul style="list-style-type: none"> <li>Secondary containment system will contain the leak. Use a temporary tank for soil storage.</li> </ul>
Sludge Storage and Thickening Tank	<ul style="list-style-type: none"> <li>Tank leak; spill of potentially hazardous materials within the facility.</li> <li>Mixer failure; fluids pumped to the filter press causing inadequate dewatering.</li> </ul>	<ul style="list-style-type: none"> <li>Secondary containment system will contain the leak. Use a temporary tank for sludge storage.</li> <li>No major impact on the filter press operation.</li> </ul>
Pretreatment Equalization Tank	<ul style="list-style-type: none"> <li>Mixer failure; not adequate mixing.</li> <li>Tank leak; spill of potentially hazardous materials within the facility.</li> </ul>	<ul style="list-style-type: none"> <li>No major impact on the treatment system.</li> <li>Bypass the pretreatment equalization tank and divert groundwater to the main equalization tank.</li> </ul>
Pretreatment Pumps	<ul style="list-style-type: none"> <li>Motor burn out in one pump.</li> </ul>	<ul style="list-style-type: none"> <li>Redundant pump provided with automatic start up.</li> </ul>
Main Equalization Tank	<ul style="list-style-type: none"> <li>Mixer failure; not adequate mixing.</li> <li>Tank leak; spill of potentially hazardous materials within the facility.</li> </ul>	<ul style="list-style-type: none"> <li>No major impact on the treatment system.</li> <li>Secondary containment system will contain the leak. A temporary tank will be needed and the pump control will need to be manual.</li> </ul>



TABLE 11-1

**DESCRIPTION OF ALTERNATE OPERATION  
(CONTINUED)**

Process Unit	Vulnerability Analysis and Impact	Alternate Operations
Main Pumps	<ul style="list-style-type: none"> <li>Motor burn out in one pump.</li> </ul>	<ul style="list-style-type: none"> <li>Redundant pump provided with automatic start up.</li> </ul>
UV Oxidation System	<ul style="list-style-type: none"> <li>Failure of UV lamp; no treatment for organic contaminants.</li> </ul>	<ul style="list-style-type: none"> <li>Bypass UV oxidation unit; ensure GAC units are online for organic treatment.</li> </ul>
Chemical Precipitation Unit	<ul style="list-style-type: none"> <li>Rapid mix tank mixer failure; reduced treatment efficiency for metals removal.</li> <li>Loss of removal efficiency in plate settler/thickener; solids carryover.</li> <li>Chemical feed system failure; no pH adjustment causing solids to stay in suspension.</li> </ul>	<ul style="list-style-type: none"> <li>Recirculate wastewater through the Main Equalization Tank for additional treatment. Ensure GAC units are online for additional removal.</li> <li>Ensure sand filter is online for solids removal.</li> <li>Ensure that pH adjustment tank is online. Solids precipitation will occur in the pH adjustment tank as the pH is increased. Ensure sand filter is online for additional solids removal.</li> </ul>
Sludge/Scum Pump	<ul style="list-style-type: none"> <li>Interruption of air supply; no solids transfer to sludge storage/thickening tank.</li> </ul>	<ul style="list-style-type: none"> <li>No major impact on treatment system. Ensure filter is on-line for removal of carry-over solids.</li> </ul>
Upflow Sand Filter	<ul style="list-style-type: none"> <li>Filter backwash system failure; reduced efficiency or backup of water into chemical precipitation unit.</li> </ul>	<ul style="list-style-type: none"> <li>Bypass filter.</li> </ul>
pH Adjustment Tank	<ul style="list-style-type: none"> <li>Mixer failure; inadequate mixing causing pH variations.</li> <li>Tank leak; spill of potentially hazardous materials within the facility.</li> <li>Chemical feed system failure; no pH adjustment.</li> </ul>	<ul style="list-style-type: none"> <li>Redundant system provided in the effluent line.</li> <li>Secondary containment system will contain the leak. Bypass tank.</li> <li>Redundant system provided in the effluent line.</li> </ul>

TABLE 11-1

**DESCRIPTION OF ALTERNATE OPERATION  
(CONTINUED)**

Process Unit	Vulnerability Analysis and Impact	Alternate Operations
Effluent Pumps	<ul style="list-style-type: none"> <li>Motor burn out in one pump.</li> </ul>	<ul style="list-style-type: none"> <li>Redundant pump provided with automatic start up.</li> </ul>
GAC Contactors	<ul style="list-style-type: none"> <li>Overload of GAC units; discharge out of compliance.</li> </ul>	<ul style="list-style-type: none"> <li>Bring in temporary GAC units for additional capacity.</li> </ul>
Sludge Pump	<ul style="list-style-type: none"> <li>Air supply interrupted; not able to dewater sludge.</li> </ul>	<ul style="list-style-type: none"> <li>Replace pump.</li> </ul>
Filter Press	<ul style="list-style-type: none"> <li>Filter Press failure; no sludge dewatering.</li> </ul>	<ul style="list-style-type: none"> <li>No major impact on the treatment facility operations. Filter press operations can be stopped while allowing sludge build up in the storage tank.</li> </ul>
Sump Pump	<ul style="list-style-type: none"> <li>Motor burn out; automatic facility shut down through the PLC.</li> </ul>	<ul style="list-style-type: none"> <li>No operations. The secondary containment system will contain any leaks during that period. Use rented or spare submersible to remove liquid.</li> </ul>
Filtrate, Decant Sump Pumps	<ul style="list-style-type: none"> <li>Motor burn out in one pump.</li> </ul>	<ul style="list-style-type: none"> <li>Redundant pump provided with automatic start up.</li> </ul>

treatment of extracted groundwater and minimize the impact of a system failure on the surrounding environment.

#### **11.4 DOCUMENTATION**

The facility operator should maintain a log of operating problems in the treatment system, potential impacts of operating problems on the system performance, and the corrective actions taken to mitigate the problem. Procedures employed to ensure that the problem does not occur in the future should also be recorded in the daily log. A copy of the operation log should be forwarded to regulatory agencies as part of the O&M submittals.

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## **Section 12**

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**MONTGOMERY WATSON**

## **12.0. EMERGENCY RESPONSE AND CONTINGENCY PLAN**

### **12.1 PURPOSE**

The purpose of the Emergency Response and Contingency Plan (ERCP) is to define procedures to protect human health and the environment both on and off-site in the event of an accident or emergency during the Perimeter Groundwater Containment System (PGCS) and the Barrier Wall and Extraction System (BWES) operation and maintenance activities. The ERCP presents procedures and policies to be implemented during the operation and maintenance (O&M) phase and delineates the responsibilities for the facility O&M contractor. Any future changes to the ERCP shall be documented by the O&M contractor as addendum to this ERCP. It's the O&M contractor's responsibility to implement the ERCP.

Emergencies can take many forms: illness or injuries, chemical exposures, fires, explosions, spills, leaks, releases of harmful chemicals, or sudden changes in the weather. It is imperative that facility personnel be prepared in the event of an emergency.

### **12.2 ELEMENTS OF THE ERCP**

This ERCP has been developed in accordance with the guidelines presented 29 CFR 1910 Part 120(1) and addresses the following elements:

- Pre-emergency planning
- Personnel roles, lines of authority, and communication
- Emergency recognition and prevention
- Safe distances and place of refuge
- Site security and control
- Evacuation routes and procedures
- Decontamination
- Emergency medical treatment and first aid
- Emergency alerting and response procedure
- Critique of response and follow-up
- Personal protective equipment and emergency equipment

The ERCP addresses these elements for normal operations and abnormal shut down of the PGCS and BWES facilities. In addition, the ERCP meets the guidelines provided in *"Guidance on EPA Oversight Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties, Appendix B, Contingency Plan (EPA, 1990)."* As suggested by EPA, the ERCP includes elements to protect the local affected population in the event of an accident or emergency, such as:

- Name of the person responsible for responding to an emergency accident
- Plan and date for meeting with the local community
- First-aid and medical information
- Air monitoring plan
- Spill control and countermeasures

### **12.3 PRE-EMERGENCY PLANNING**

There will be a pre-emergency planning meeting during which Site personnel will be supplied with a copy of this ERCP and the Health and Safety Plan (HSP). The Site Safety Officer (SSO) will discuss Site operations and the workers will be instructed in the recognition, avoidance, and prevention of unsafe activities and conditions. Emergency procedures will be discussed during the meeting.

The pre-emergency planning meeting will also discuss the role and responsibilities of key personnel and lay down the lines of communications. Each personnel assigned to the site will be trained in conformance with pertinent OSHA regulations including 29 CFR 1910.120.

### **12.4 KEY PERSONNEL AND RESPONSIBILITIES**

The following describes the role and responsibilities of key personnel assigned to PGCS and BWES operation and maintenance.

#### **12.4.1. Project Manager**

As Project Manager (PM), Dr. Peter Vagt will be overall responsible for the PGCS and BWES O&M activities, for assigning field personnel and interacting with the operations staff on a regular basis, and for ensuring that all activities are conducted in a safe manner

and in accordance with approved documents. He will also be responsible for communicating information to the ACS Steering Committee and the regulatory agencies Project Coordinators per a mutually agreed-upon schedule.

#### **12.4.2. Site Safety Officer**

Mr. Lee Orosz will be responsible for maintaining proper medical surveillance, providing hazard communication information, training employees in safe operating procedures, and advising the PM on any matters concerning the health and safety of the employees or the public. The Site Safety Officer (SSO) may be required to perform various types of area or personnel monitoring for purposes of determining worker exposure and proper selection of personal protective equipment (PPE) if unforeseen chemical hazards are encountered. The SSO should be consulted when any changes in the recommended procedures or levels of PPE are made. Mr. Orosz will also act as a supporting operator for the PGCS and BWES facilities and assist the lead operator in daily activities.

#### **12.4.3. Lead Operator**

Mr. Ben McGeachy will be the lead operator responsible for day-to-day operations of the PGCS and BWES. In this capacity, he will be responsible for ensuring that all system components work as designed and that the extraction and treatment facilities operate in accordance with the design criteria. He will also be responsible for the facility maintenance including scheduled and equipment maintenance, replacement parts ordering and stocking, facility start up and shut down, on-site analytical work, and preparation of the operation logs.

#### **12.4.4. Engineering Manager**

Mr. Tom Tutein will be responsible for the successful execution and administration of all engineering-related activities at the PGCS and BWES. Primary responsibilities include development of operational procedures and updating the procedures as needed, incorporating changes to the facility design to enhance the system performance, preparation of agency submittals to document changes and additions, and for ensuring that the sampling and analysis plan is implemented per the approved documents.

#### **12.4.5. Operations Manager**

Mr. Todd Lewis will be overall in charge of the PGCS and BWES operation and maintenance. In this capacity, Mr. Lewis will direct the lead operator for day-to-day activities, coordinate with SSO to ensure safe operating environment, and advise the PM on matters concerning the facilities operation. He will also interact with the Project Manager and Engineering Manager during implementation of potential changes to the system design.

#### **12.4.6. Project Personnel Contact Numbers**

<b>Contact Name</b>	<b>Project Role</b>	<b>Business Phone</b>	<b>Residence Phone</b>
Peter Vagt	Project Manager	(630) 691-5020	(630) 665-4629
Lee Orosz	Site Safety Officer/ Supporting Operator	(219)924-4607	(219) 462-2308
Ben McGeachy	Lead Operator	(219) 924-4607	(219) 836-0787
Tom Tutein	Engineering Manager	(630) 691-5064	(847) 639-4536
Todd Lewis	Operations Manager	(630) 691-5061	(708) 424-0891

### **12.5 SITE SECURITY PLAN**

Security measures have been implemented to minimize the possibility for unauthorized entry to the extraction and treatment facilities. The access road is blocked by a chain gate to control access. The treatment facility is housed inside a building that will remain locked at all times when no operating personnel are present. The main entrance to the building will remain closed to prevent unauthorized entry. Personnel entering the PGCS facility will park outside the building and will not be allowed to enter the building until signing in with the operations personnel. A sign stating "Warning - Unauthorized Personnel Keep Out," will be posted at the building entrance. A set of keys to the building will be kept by the following people:

- Site Safety Officer and Supporting Operator
- Lead Operator
- Project Manager



If there has been a security violation, the PM will be notified immediately. The PM will be responsible for notifying the ACS Steering Committee and for initiating further measures. The operations personnel will prepare a written statement describing the events of the security violation within 24 hours of the incident and submit the statement to the PM. The report content will include the nature of security violation, approximate time period of the event, impact of security violation on the facility, and if a facility shut down may be required.

## **12.6 GENERAL SAFETY**

This section presents some of the safety hazards associated with operation of the PGCS and BWES. It is not intended to be all inclusive. The Site Health and Safety Plan and the Health and Safety Plan Addendum contain more extensive safety information relative to the activities that commonly occur at the Site and should be consulted.

Proper safety procedures and equipment cannot be overemphasized. System operators must acquaint themselves with the hazards associated with system maintenance and operation, and take the necessary steps to avoid them.

### **12.6.1. Oxygen Deficiency**

Oxygen deficiency can occur in any confined space such as the equalization tank, sludge storage tank, building sumps, or GAC units. Oxygen deficiency is an asphyxiation hazard which results when air is replaced by some other gas, whether it is toxic or not. The necessary precautions should be taken to assure ample ventilation when entering any confined space. More specific instructions and a confined space entry permit are included in the Site Health and Safety Plan. Before entry into a confined space these instructions should be reviewed and a confined space permit should be completed and filed.

### **12.6.2. Chemical Hazards**

This section provides a summary of chemical hazards for chemicals that will be routinely stored at the site. An MSDS for each chemical is included at the end of this section.

**12.6.2.1. Hydrogen Peroxide.** Hydrogen Peroxide ( $H_2O_2$ ) is added to the UV/Oxidation system to convert organic contaminants to carbon dioxide, water and inert salts. Fifty-percent (50%) solution is purchased in bulk. The solution is also known as hydrogen dioxide, hydroperoxide, and peroxide. Hydrogen peroxide is a colorless solution with a slightly sharp odor. The solution is a non-combustible liquid but a powerful oxidizer. Contact with combustible material may result in SPONTANEOUS combustion. Inhalation, ingestion, or contact (skin, eyes) with vapors or substance may cause severe injury, burns, or death. In case of contact, immediately flush skin or eyes with running water for at least 20 minutes, move the victim to fresh air, and call emergency medical care. When working with the solution, personnel should wear protective clothing such as gloves, face shields and aprons.

**12.6.2.2. Sodium Hydroxide.** Sodium hydroxide (NaOH) is added to the water to increase the pH and cause precipitation of metal hydroxides. 50-percent solution of sodium hydroxide is purchased in bulk. The solution is also known as lye or caustic soda. NaOH is extremely alkaline and is very corrosive to body tissues and may cause burns. If the solution comes into contact with the eyes or skin, immediately flush the affected area with water and if necessary seek medical help. When working with the solution, personnel should wear protective clothing such as gloves, face shields and rubber aprons. A weak acid solution such as vinegar can be used to neutralize NaOH spills.

**12.6.2.3. Sulfuric Acid.** Sulfuric acid ( $H_2SO_4$ ) is added to the water to adjust the pH of the water following the precipitation system. 93-percent acid is purchased in bulk. The acid is highly corrosive and may burn the eyes, skin and mucous membranes. Ingestion may be fatal. If the acid comes into contact with the eyes or skin, immediately flush the affected area with water and/or sodium bicarbonate solution and if necessary seek medical help. When working with the acid, personnel should wear protective clothing such as gloves, boots, face shields and rubber aprons. Respiratory protection should be worn when there is the possibility of exposure to acid vapors. A supply of sodium bicarbonate (baking soda) should be kept on-site to neutralize any acid spills.

**12.6.2.4. Chemical Safety Equipment.** Two emergency eyewash and safety showers are provided--one is located outside at the chemical delivery truck pad and one is located inside near the chemical storage area--for use in the event of an accident involving any of the chemicals used in the facility. As previously mentioned, personnel should wear

protective clothing such as chemical resistant gloves, boots, face shields and rubber aprons when working with any of the chemicals. Drums containing chemicals should be stored in designated and delineated areas and should be placed on containment pallets when opened to catch any drips. Several fifty pound bags of sodium bicarbonate should be kept on-site for use in neutralizing spills of acid or base. A commercial spill containment kit with adsorbents and containment supplies should also be maintained at the facility.

## **12.7 AIR MONITORING PLAN**

Volatile organic compounds will be monitored during the PGCS and BWES operation. Emissions monitoring will be conducted in accordance with the guidelines established by the local regulatory agencies. Portable field equipment will be kept at the site at all times to adequately characterize the vapors and to plan for personal protective equipment.

## **12.8 SPILL AND DISCHARGE CONTROL PLAN**

The PGCS facility is designed to treat extracted groundwater; hence a potential exists for spill of contaminated groundwater. In addition, several chemicals are to be stored on-site to treat extracted groundwater and to analyze treated groundwater. This spill and discharge control plan addresses methods, means, and facilities provided to (1) prevent a spill or uncontrolled discharge of contaminated groundwater or chemicals, (2) prevent further contamination of the environment, structures, equipment, or materials resulting from potential accidental spills, (3) protect the ACS employees from potential hazards at the site, and to (4) ensure public health and safety.

### **12.8.1. Control Procedures and Protective Measures**

The PGCS treatment facility design incorporates a secondary containment to contain the spilled material. Equipment and personnel are provided to perform emergency measures necessary to contain spills and to remove spilled materials and associated contaminated material. A spill kit is to be maintained on site during at all times. The spill kit contains a DOT-approved container, sorbing material, shovels and brooms, personnel protective clothing (Tyvek, gloves, safety glasses, and industrial boots), and adequate polyethylene sheeting to contain a spill. The waste generated as a result of any spill will be collected

on site, properly containerized, and either treated through the PGCS treatment facility or transported to an authorized off-site disposal facility.

### **12.8.2. Decontamination Procedures**

Decontamination procedures may be required after cleanup to eliminate traces of the substances spilled or to reduce it to an acceptable level. Personnel and equipment decontamination shall occur as specified in 29 CFR 1910.120.

### **12.8.3. Spill Notification**

In the event of a spill, the facility operator(s) shall take the following actions:

1. Assess the need to don a higher level of PPE. This assessment will depend on the volume of the spill, nature of the spilled material, and measurements from air monitoring equipment.
2. In the event that the spill is too large to be handled safely by the facility operator, the area around the spill should be secured. The Site Safety Office (SSO) should initiate clean-up activities by notifying the appropriate emergency or spill response organization.
3. Immediately notify officials at the ACS facility (219-924-4370) so that proper precautionary measures can be taken to protect ACS employees.
4. **Control and Contain the Spill:** Operator should anticipate the type of spill control materials they may need in advance of mobilization. Spill control materials include spill pillows, pigs (long absorbent tubes), neutralizing chemicals for caustic and acidic spills, activated carbon for organic spills and non-sparking shovels and overpack drums or inert drum liners.
5. **Initiate Spill Clean Up:** Pump or scoop up the spilled material and affected soil or articles, and placing the material in a drum or other suitable container. This should be done in the appropriate level of PPE.

For groundwater spills, the area affected by the spill should be minimized by diking and any free water should be cleaned up. Sampling of the affected area should then be carried out to confirm clean up to the desired levels.

6. **Decontaminate the Tools and Personnel:** Drums or other containers should be on site to store decontamination fluids and waste PPE. All field team members should exercise care when decontaminating equipment and personnel, and should treat any spilled decontamination water or fluid as a hazardous material.
7. Once efforts to mitigate the spill are underway, notify the ACS Steering Committee of the nature of the spill and the response action. The ACS Steering Committee is responsible for notifying the regulatory agencies within 10 days of any unauthorized spill in accordance with the requirements of 49 CFR 171.15 and other regulatory requirements. 49 CFR 171.15 requires regulatory notification of unauthorized spills which exceed 450 liters (119 gallons) for liquids and/or 400 kg (882 pounds) for solids, and could be used as a threshold for regulatory notification. The reportable quantities for the major chemicals used at the site are:

Sulfuric Acid	-	1,000 lbs
Sodium Hydroxide	-	1,000 lbs
Hydrogen Peroxide	-	10 lbs

## 12.9 EMERGENCY ASSISTANCE INFORMATION

### 12.9.1. General Procedures

The following procedures shall be followed in the event of an emergency:

- In accordance with 29 CFR 1910.120(1), the operator or operations contractor should establish facility evacuation routes and an emergency medical assistance network.

- The fire department, ambulance service, and clinic or hospital room should be identified and phone numbers for these services posted in a conspicuous place with the facility.
- The SSO will inform the local medical facility before site operations commence. The SSO will provide the medical facility general information of on-site chemical hazards that may be encountered, in addition to Site location and time of work activities.
- Every attempt to rapidly identify substances to which the worker has been exposed shall be made. This information will be given to medical personnel in the event of an emergency.
- Procedures for decontamination of injured workers and preventing contamination of medical personnel, equipment, and facilities shall be communicated to the workers.

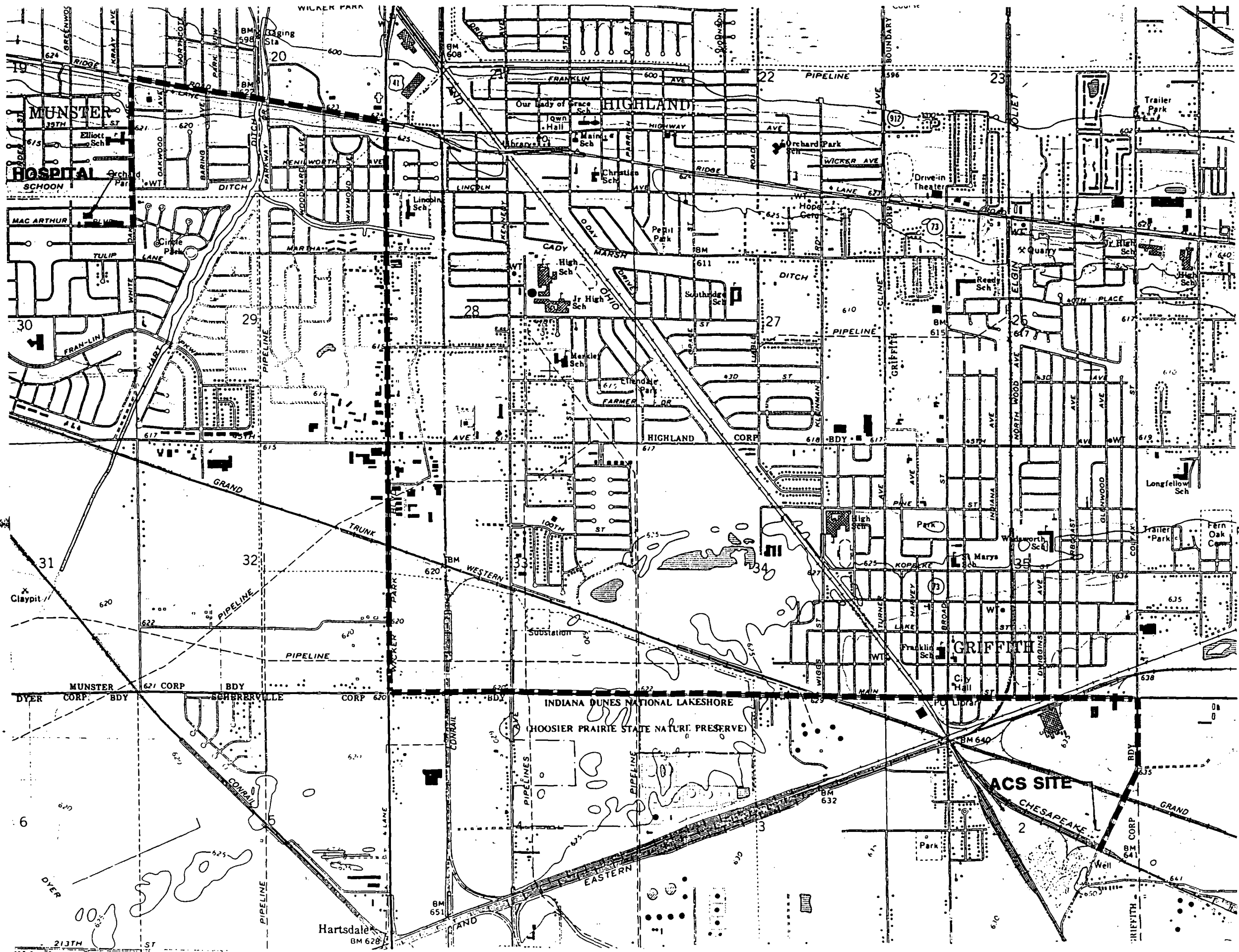
Emergency assistance information is provided in this section and a map delineating the route to the closest emergency room is shown in Figure 12-1. A vehicle shall be available on site during work hours to transport injured personnel to the emergency hospital.

#### **12.9.2. Emergency Hospital**

**Munster Community Hospital** (219) 836-1600  
**901 McArthur Boulevard, Munster, Indiana**

**Driving Direction to Hospital:** Exit site onto Colfax north to Main Street. Take left onto Main, head west to Indianapolis Boulevard (Route 41). Take right onto 41 (north) to Ridge Road. Take left onto Ridge Road (west) to Calumet Avenue. Turn left onto Calumet Avenue (south). Hospital emergency entrance is on east side of the street, just pass Fisher Street.

AMERICAN CHEMICAL SERVICE INC. 10/1/68



Drawing Number 20007030 B9	
MONTGOMERY WATSON	
AMERICAN CHEMICAL SERVICE INC. GRIFFITH, INDIANA	
SITE LOCATION MAP AND HOSPITAL ROUTE	
Developed By ACC	Drawn By TMS/ACC
Approved By	Date
Reference	Revisions

### **12.9.3. Emergency Contact Numbers**

<b>American Chemical Service</b>	<b>(219) 924-4370</b>
<b>Ambulance</b>	<b>911</b>
<b>Fire and Rescue</b>	<b>911</b>
<b>Highway Patrol</b>	<b>911</b>
<b>Paramedics</b>	<b>911</b>
<b>Police</b>	<b>911</b>
<b>Sheriff</b>	<b>911</b>
<b>Toxic Chemical Spill</b>	<b>(800) 334-1697</b>
<b>EPA Emergency Response</b>	<b>(312) 353-2318</b>
<b>Poison Control</b>	<b>(800) 942-5969</b>
<b>National Response Center</b>	<b>(800) 424-8802</b>

### **12.9.4. Emergency Equipment and First Aid**

The following emergency equipment shall be maintained at the PGCS facility:

- First-aid equipment and supplies
- Type ABC fire extinguisher, 10-pound capacity. A minimum of two fire extinguishers should be kept at the site at all times.
- Emergency eyewash station and shower are located in the treatment facility
- Emergency use respiratory equipment sufficient to protect the operator from particulates, organic vapors and acidic or corrosive gases

The first aid shall include the following at a minimum:

- Disposable mouth-to-mouth resuscitator
- Disposable gloves and overgarments
- Safety goggles and face mask

Whenever first aid procedures are performed on another person, the Site Safety Officer must be notified as soon as possible.



### **12.9.5. Personal Protective Equipment**

The following outlines the PPE to be utilized at the PGCS facility:

- Safety Boots - Steel toe/steel shank
- Hard Hat
- Safety Glasses with wide shields
- Face Shield
- Hearing Protection

### **12.9.6. Medical Emergency Procedures**

Any person who becomes ill or injured must be decontaminated as soon as possible, giving consideration to which risk will be greater, the spread of contamination or any potential health effects of the individual. If the victim is stable, decontamination is to be completed and First Aid administered as needed prior to transport. If the patient's condition is unstable, only gross decontamination is to be completed (i.e., removal of PPE if necessary), to prevent injury to responder, prior to administering First Aid. First Aid should be administered while awaiting an ambulance or paramedics as appropriate to the injury.

Anyone being transported to a clinic or hospital for treatment should have available to them information on any potential chemical(s) to which they could have been exposed at the Site, along with their medical history.

## **12.10 COMMUNITY RELATIONS PLAN**

As part of pre-emergency planning, the O&M contractor will work with EPA to schedule regular meetings with the local communities. The meeting will include representatives from the local, state, and federal agencies who are involved with the PGCS treatment facility. The contractor-prepared addendum to the ERCP will specify the meeting time, place, and attendees.

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CONSULTING/STE 200  
365 LENNON LANE  
WALNUT CREEK CA 94598

07/17/93

DEAR CUSTOMER:

ENCLOSED ARE THE MATERIAL SAFETY DATA SHEETS (MSDS'S) FOR THE PRODUCT(S) THAT YOUR COMPANY RECENTLY PURCHASED FROM VWR SCIENTIFIC. PLEASE FORWARD THESE MSDS(S) TO YOUR SAFETY OFFICER OR OTHER INDIVIDUAL IN YOUR ORGANIZATION RESPONSIBLE FOR IMPLEMENTING THESE REGULATIONS.

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THANK YOU,

VWR SCIENTIFIC

# 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURER.....:

EM SCIENCE  
A DIVISION OF EM INDUSTRIES  
P.O. BOX 70  
480 DEMOCRAT RD.  
GIBBSTOWN, N.J. 08027

PREPARATION DATE.: 03/01/91

DATE MSDS PRINTED.: JUN 11, 1992

INFORMATION PHONE NUMBER.: 609-354-9200

HOURS: MON. TO FRI. 8:30-5

CHEMTREC EMERGENCY NUMBER: 800-424-9300

HOURS: 24 HRS A DAY

CATALOG NUMBER(S):

HX0630

CHEMICAL NAME.....: HYDROGEN PEROXIDE SOLUTION, 50%

TRADE NAME.....: HYDROGEN DIOXIDE

CHEMICAL FAMILY...: PEROXIDE

FORMULA.....: H2O2

MOLECULAR WEIGHT.: 34.02

## 2. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS #	APPR %
HYDROGEN PEROXIDE	7722-84-1	50%
WATER	7732-18-5	50%

## 3. HAZARDS IDENTIFICATION

### EMERGENCY OVERVIEW

STRONG OXIDIZER.

LABORATORY TESTS INDICATE MATERIAL MAY BE CARCINOGENIC.

CAUSES BURNS.

CAN BE TOXIC BY INGESTION.

HARMFUL IF INHALED.

MAY CONTAIN GAS UNDER PRESSURE.

CONTAMINATION MAY RESULT IN DANGEROUS PRESSURE.

APPEARANCE.....:

CLEAR, COLORLESS LIQUID WITH SHARP ODOR

## POTENTIAL HEALTH EFFECTS (ACUTE AND CHRONIC)

### SYMPTOMS OF EXPOSURE:

EYES: SEVERE DAMAGE, POSSIBLY DELAYED; POSSIBLE BLINDNESS.

INHALATION: IRRITATION OF NASAL & RESPIRATORY PASSAGES.

BLEACHING, BLISTERING OF SKIN ON CONTACT.

TOXIC AND CORROSIVE BY INGESTION.

### MEDICAL COND. AGGRAVATED BY EXPOSURE:

DATA NOT AVAILABLE.

### ROUTES OF ENTRY.....:

INHALATION, INGESTION

### CARCINOGENICITY.....:

THERE IS "LIMITED EVIDENCE" THAT H<sub>2</sub>O<sub>2</sub> IS CARCINOGENIC TO EXPERIMENTAL ANIMALS (IARC: 36, 1985) HOWEVER, IT IS IMPROBABLE THAT HUMANS WILL BE EXPOSED TO HIGH ORAL DOSES DUE TO ACUTE TOXICITY OF CONCENTRATED SOLUTIONS AND CORROSIVITY OF H<sub>2</sub>O<sub>2</sub> TO MUCOUS MEMBRANES.

## 4. FIRST AID MEASURES

### EMERGENCY FIRST AID:

GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE.

SKIN: IMMEDIATELY FLUSH THOROUGHLY WITH LARGE AMOUNTS OF WATER.

EYES: IMMEDIATELY FLUSH THOROUGHLY WITH WATER FOR AT LEAST 15 MINUTES.

INHALATION: REMOVE TO FRESH AIR; GIVE ARTIFICIAL RESPIRATION IF BREATHING HAS STOPPED.

INGESTION: DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER FREELY AND GET MEDICAL ATTENTION.

REMOVE CONTAMINATED CLOTHING AND WASH BEFORE REUSE.

## 5. FIRE FIGHTING MEASURES

FLASH POINT (F).....: NONCOMBUSTIBLE

FLAMMABLE LIMITS LEL (%): N/A

FLAMMABLE LIMITS UEL (%): N/A

EXTINGUISHING MEDIA.....:

WATER; FLOOD FIRE-EXPOSED CONTAINERS WITH WATER TO COOL.

FIRE FIGHTING PROCEDURES.:

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING.

FIRE & EXPLOSION HAZARDS.:

DECOMPOSITION RELEASES OXYGEN WHICH MAY INTENSIFY FIRE.

## 6. ACCIDENTAL RELEASE MEASURES

**SPILL RESPONSE:**

EVACUATE THE AREA OF ALL UNNECESSARY PERSONNEL.

WEAR SUITABLE PROTECTIVE EQUIPMENT LISTED UNDER EXPOSURE / PERSONAL PROTECTION.

ELIMINATE ANY IGNITION SOURCES UNTIL THE AREA IS DETERMINED TO BE FREE FROM EXPLOSION OR FIRE HAZARDS.

CONTAIN THE RELEASE AND ELIMINATE ITS SOURCE, IF THIS CAN BE DONE WITHOUT RISK.

TAKE UP AND CONTAINERIZE FOR PROPER DISPOSAL AS DESCRIBED UNDER DISPOSAL.

COMPLY WITH FEDERAL, STATE, AND LOCAL REGULATIONS ON REPORTING RELEASES. REFER TO REGULATORY INFORMATION FOR REPORTABLE QUANTITY AND OTHER REGULATORY DATA.

EM SCIENCE RECOMMENDS SPILL-X NEUTRALIZERS AND ABSORBENT AGENTS FOR VARIOUS TYPES OF SPILLS.

ADDITIONAL INFORMATION ON THE SPILL-X PRODUCTS CAN BE PROVIDED THROUGH THE EM SCIENCE TECHNICAL SERVICE DEPARTMENT (609) 354-9200.

THE FOLLOWING EM SCIENCE SPILL-X NEUTRALIZER AND ABSORBENT IS RECOMMENDED FOR THIS PRODUCT:

SX0861

ACID SPILL TREATMENT KIT

**7. HANDLING AND STORAGE**

**HANDLING & STORAGE:**

VENT ALL CONTAINERS TO PREVENT PRESSURE BUILD-UP; KEEP UPRIGHT. DO NOT BREATHE VAPOR.

STORE IN A COOL AREA AWAY FROM COMBUSTIBLE MATERIAL AND CATALYTIC METALS.

DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING.

AVOID EXCESSIVE HEAT AND CONTAMINATION OF ANY KIND.

RETAINED RESIDUE MAY MAKE EMPTY CONTAINERS HAZARDOUS; USE CAUTION.

NEVER RETURN UNUSED HYDROGEN PEROXIDE TO ORIGINAL CONTAINER.

**8. EXPOSURE CONTROLS / PERSONAL PROTECTION**

**ENGINEERING CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT:**

**VENTILATION, RESPIRATORY PROTECTION, PROTECTIVE CLOTHING, EYE PROTECTION**

RESPIRATORY PROTECTION: IF WORKPLACE EXPOSURE LIMIT(S) OF PRODUCT OR ANY COMPONENT IS EXCEEDED (SEE TLV/PEL), A NIOSH/MSHA APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS (NEGATIVE PRESSURE TYPE) UNDER SPECIFIED CONDITIONS (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING

MSDS (CONTINUED) - HX0630

PAGE # 3

AND/OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

MATERIAL SHOULD BE HANDLED OR TRANSFERRED IN AN APPROVED FUME HOOD OR WITH ADEQUATE VENTILATION.

PROTECTIVE GLOVES (RUBBER, NEOPRENE OR EQUIVALENT) MUST BE WORN TO PREVENT SKIN CONTACT.

PROTECTIVE CLOTHING (IMPERVIOUS)

SHOULD BE WORN WHEN HANDLING THIS MATERIAL.

SAFETY GLASSES WITH SIDE SHIELDS MUST BE WORN AT ALL TIMES.

#### WORK / HYGENIC PRACTICES:

WASH THOROUGHLY AFTER HANDLING.

DO NOT TAKE INTERNALLY.

EYE WASH AND SAFETY EQUIPMENT SHOULD BE READILY AVAILABLE.

---

#### EXPOSURE GUIDELINES

##### OSHA - PEL:

COMPONENT	TWA		STEL		CL		SKIN
	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	
HYDROGEN PEROXIDE	1	1.4					
WATER							

---

##### ACGIH - TLV:

COMPONENT	TWA		STEL		CL		SKIN
	PPM	MG/M3	PPM	MG/M3	PPM	MG/M3	
HYDROGEN PEROXIDE	1	1.4					
WATER							

#### 9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT (C 760 MMHG): 114C

MELTING POINT (C): -52C

SPECIFIC GRAVITY (H2O = 1): 1.196

VAPOR PRESSURE (MM HG): 18 30C

PERCENT VOLATILE BY VOL (%): 50

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VAPOR DENSITY (AIR = 1).....: 0.9  
EVAPORATION RATE (BUAC = 1): >1  
SOLUBILITY IN WATER (%):.....: MISCIBLE  
APPEARANCE.....:  
CLEAR, COLORLESS LIQUID WITH SHARP ODOR

## 10. STABILITY AND REACTIVITY

STABILITY.....: NO  
HAZARDOUS POLYMERIZATION:  
DOES NOT OCCUR

HAZARDOUS DECOMPOSITION.:  
OXYGEN WHICH SUPPORTS COMBUSTION

CONDITIONS TO AVOID.....:

CONTAMINATION OF ANY KIND.  
EXCESSIVE HEAT WHICH ACCELERATES DECOMPOSITION.

MATERIALS TO AVOID.....:

( ) WATER  
( ) ACIDS  
( ) BASES  
( ) CORROSIVES  
( ) OXIDIZERS  
(X) OTHER :

COMBUSTIBLE MATERIALS, POWDERED METALS, RUST, DIRT, ORGANICS

## 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA:

NONE ESTABLISHED

TOXICOLOGICAL FINDINGS:

TESTS ON LABORATORY ANIMALS INDICATE MATERIAL MAY CAUSE TUMORS  
CITED IN REGISTRY OF TOXIC EFFECTS OF SUBSTANCES (RTECS)

## 12. DISPOSAL CONSIDERATIONS

EPA WASTE NUMBERS: D002

TREATMENT:

INCINERATION, FUELS BLENDING OR RECYCLE. CONTACT YOUR LOCAL  
PERMITTED WASTE DISPOSAL SITE (TSD) FOR PERMISSIBLE TREATMENT  
SITES.

ALWAYS CONTACT A PERMITTED WASTE DISPOSER (TSD) TO ASSURE

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COMPLIANCE WITH ALL CURRENT LOCAL, STATE AND FEDERAL REGULATIONS.

13. TRANSPORT INFORMATION

DOT PROPER SHIPPING NAME....:  
HYDROGEN PEROXIDE SOLUTION, 50%  
DOT ID NUMBER.....: UN2014

14. REGULATORY INFORMATION

TSCA INVENTORY.....:  
THIS PRODUCT IS A "MIXTURE". THE CAS NUMBERS OF ALL COMPONENTS  
ARE LISTED ON THE TSCA INVENTORY.

COMPONENT	SARA EHS (302)	SARA EHS TPQ (LBS)	CERCLA RQ (LBS)
HYDROGEN PEROXIDE	Y	1000	1

WATER

COMPONENT	OSHA FLOOR LIST	SARA 313	DEMINIMIS FOR SARA 313 (%)
HYDROGEN PEROXIDE	Y		

WATER

15. OTHER INFORMATION

COMMENTS:

NONE

NEPA HAZARD RATINGS:

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HEALTH : 2  
FLAMMABILITY : 0  
REACTIVITY : 1  
SPECIAL HAZARDS: OXY

REVISION HISTORY:

08/01/84 04/01/85 06/29/87 10/27/87 03/27/90

= REVISED SECTION

N/A = NOT AVAILABLE

N/E = NONE ESTABLISHED

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"ISSUED BY VWR 07/17/93"



# Genium Publishing Corporation

1145 Catalyn Street  
Schenectady, NY 12303-1836 USA  
(518) 377-8854

Material

Sheet No. .  
Sodium Hydroxide

Issued: 10/77

Sodium Hydroxide

Revision: C, 11/91

## Section 1. Material Identification

**Sodium Hydroxide (NaOH) Description:** Derived by electrolysis of sodium chloride brines, by reacting calcium chloride with sodium carbonate, or by electrolytic production using the diaphragm cell. Sodium hydroxide often contains as impurities minimal amounts of sodium chloride, sodium carbonate, sodium sulfate, sodium chlorate, iron, or nickel. Used to hydrolyze fats and form soaps; in making plastics to dissolve casein; in treating cellulose to make rayon and cellophane; in explosives, dyestuffs, electrolytic extraction of zinc, reclaiming rubber, tin plating, oxide coating, etching and electroplating, laundering and bleaching, pulp and paper manufacture; in vegetable oil refining; in peeling of fruits and vegetables in the food industry; and in veterinary medicine as a disinfectant.

**Other Designations:** CAS No. 1310-73-2; Aetznatron; caustic soda; Collo-Grillrein; Collo-Tapette; Feurs Rohp; Lewis-Red Devil Lye; soda hydrate; soda lye; sodium hydrate.

**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*<sup>TM</sup> for a suppliers list.

**Cautions:** Sodium hydroxide is moderately toxic by ingestion and inhalation and can be seriously corrosive to eyes, skin, and mucous membranes.

R 0 NFPA  
I 2  
S 4  
K 0



HMS  
H 3  
F 0  
R 1  
PPG\*  
\* Sec. 1

## Section 2. Ingredients and Occupational Exposure Limits

Sodium hydroxide, ca 100%

1990 OSHA PEL  
Ceiling: 2 mg/m<sup>3</sup>

1990 DFG (Germany) MAK  
2 mg/m<sup>3</sup>

1990 IDLH Level  
250 mg/m<sup>3</sup> (solution mists)

1990 NIOSH REL  
Ceiling: 2 mg/m<sup>3</sup>

### 1985-86 Toxicity Data\*

Rabbit, oral, LD<sub>50</sub>: 500 mg/kg; no toxic effect noted

Rabbit, skin: 500 mg applied over 24 hr causes severe irritation

Mouse, intraperitoneal, LD<sub>50</sub>: 40 mg/kg; toxic effects not yet reviewed

1991-92 ACGIH TLV  
Ceiling: 2 mg/m<sup>3</sup>

\* See NIOSH, RTECS (WB4900000), for additional irritation, mutation, and toxicity data.

## Section 3. Physical Data

Boiling Point: 2534 °F (1390 °C)

Melting Point: 605 °F (318.4 °C)

Vapor Pressure: 1 mm Hg at 1362 °F (739 °C)

pH (0.5% solution): 13

Molecular Weight: 40.01

Specific Gravity: 2.13 at 77 °F (25 °C)

Water Solubility: 1 g/0.9 ml water, 1 g/0.3 ml boiling water

Other Solubilities: 1 g/7.2 ml alcohol, 1 g/4.2 ml methanol, soluble in glycerol; insoluble in acetone and ether

**Appearance and Odor:** Odorless, hygroscopic (readily absorbs water) white flakes, cake, lumps, chips, pellets, or sticks.

## Section 4. Fire and Explosion Data

Flash Point: None reported

Autoignition Temperature: None reported

LEL: None reported

UEL: None reported

**Extinguishing Media:** Although noncombustible as a solid, when in contact with moisture or water sodium hydroxide can generate enough heat to ignite surrounding combustibles. If possible without risk, remove containers from area. Use extinguishing agents suitable for surrounding fire. For small fire, use dry chemical, carbon dioxide (CO<sub>2</sub>), or regular foam. Avoid water spray since water reacts with sodium hydroxide to generate substantial heat. If you must use water, be sure it is as cold as possible. For large fires, use fog or regular foam.

**Unusual Fire or Explosion Hazards:** Sodium hydroxide may melt and flow when heated.

**Special Fire-fighting Procedures:** Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear fully protective clothing. Structural firefighters' protective clothing provides limited protection. Apply cooling water to fire-exposed sides of container until fire is well out. Do not splatter or splash this material. Stay away from ends of tanks. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

## Section 5. Reactivity Data

**Stability/Polymerization:** Sodium hydroxide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Violent polymerization can occur when in contact with acrolein or acrylonitrile. Since sodium hydroxide readily absorbs water and carbon dioxide from air, keep containers tightly closed.

**Chemical Incompatibilities:** Sodium hydroxide generates large amounts of heat when in contact with water and may steam and splatter. It reacts with mineral acids to form corresponding salts; reacts with weak-acid gases like hydrogen sulfide, sulfur dioxide, and carbon dioxide; ignites when in contact with cinnamaldehyde or zinc; and has exploded when exposed to a mixture of chloroform and methane. Sodium hydroxide can be very corrosive to metals such as aluminum, tin, and zinc as well as to alloys such as steel, and may cause formation of flammable hydrogen gas. An increase in temperature and pressure occurs in closed containers when sodium hydroxide is mixed with: acetic anhydride, glacial acetic acid, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, oleum, 36% hydrochloric acid, 48.7% hydrofluoric acid, 70% nitric acid, or 96% sulfuric acid.

**Conditions to Avoid:** Avoid generation of sodium hydroxide dusts, and contact with water, metals, and the chemicals listed above.

**Hazardous Products of Decomposition:** Thermal oxidative decomposition of sodium hydroxide can produce toxic sodium oxide (Na<sub>2</sub>O) and sodium peroxide (Na<sub>2</sub>O<sub>2</sub>) fumes.

## Section 6. Health Hazard Data

**Carcinogenicity:** In 1990 reports, the IARC, NTP, and OSHA do not list sodium hydroxide as a carcinogen (see Chronic Effects).

**Summary of Risks:** Sodium hydroxide is toxic by inhalation of dusts or mists, ingestion, or direct skin or eye contact. Damage is immediate and without prompt medical attention can become permanent. This strong, corrosive alkali dissolves any living tissue it contacts.

**Medical Conditions Aggravated by Long-Term Exposure:** None reported.

**Target Organs:** Eyes, digestive tract, respiratory system, and skin.

**Primary Entry Routes:** Ingestion, inhalation, and skin and eye contact.

Continue on next page

**Section 6. Health Hazard Data, continued**

**Acute Effects:** Ingestion causes immediate burning of mouth, esophagus, and stomach; painful swallowing; excessive salivation; edematous (excess fluid in surrounding tissue) lips, chin, tongue, and pharynx covered with exudate (fluid oozed from swollen tissue); esophageal edema (swelling from fluid buildup in esophagus walls that can prevent all swallowing within hours); possibly edematous, gelatinous, and necrotic (localized tissue death) mucous membranes; vomiting (sometimes coffee grounds-like material due to digestive hemorrhage); and rapid, faint pulse; and cold, clammy skin. Death results commonly from shock, asphyxia (oxygen loss due to interrupted breathing), or pneumonia by the second or third day after ingestion. Dust inhalation can cause many small burns, temporary hair loss (in nasal passages since sodium hydroxide breaks down keratin), and possibly pulmonary edema (fluid in lungs). Skin contact causes slippery, soapy feeling that is not usually painful for 3 min after contact—even though skin damage begins immediately. It causes burns, keratin (hair and nails) destruction, and intracellular edema (excess fluid in skin cells), with damage progressing to severe burns, tissue corrosion, deep ulcerations, and permanent scarring if not immediately washed off. The cornea begins to corrode on contact. Disintegration and sloughing of conjunctival and corneal epithelium may progress to temporary or permanent corneal opacification (cloudiness, becoming impervious to light) or symblepharon (adhesion of lid to eyeball).

**Chronic Effects:** Dermatitis may result from repeated exposure to dilute solutions. Cases of squamous cell carcinoma (malignant tumors of epithelial origin) of the esophagus are reported 12 to 42 years after sodium hydroxide ingestion, although it is unclear whether the cancer results from scar formation caused by tissue destruction or directly from the chemical's possible carcinogenicity.

**FIRST AID:** Emergency personnel should protect against contamination.

**Eyes:** Gently lift the eyelids and flush immediately and continuously with flooding amounts of cold water until transported to an emergency medical facility. *Do not* allow victim to keep eyes tightly shut. **Warning!** Although splashed directly in only one eye, sodium hydroxide may affect the other eye's sight if prompt medical attention is not received. Consult a physician immediately.

**Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. *Be aware* that this substance can become very hot when in contact with water. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

**Inhalation:** Remove exposed person to fresh air and support breathing as needed.

**Ingestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water, followed by vinegar or fruit juice to neutralize the poison. *Do not induce vomiting!*

After first aid, get appropriate in-plant, paramedic, or community medical support.

**Note to Physicians:** Perform endoscopy in all suspected cases of sodium hydroxide ingestion. Perform blood analysis to determine if dehydration, acidosis, or other electrolyte imbalances have occurred.

**Section 7. Spill, Leak and Disposal Procedures**

**Spill/Leak:** Notify safety personnel, isolate hazard area, deny entry, and stay upwind of spills. Cleanup personnel should protect against vapor inhalation and skin or eye contact. Use water spray to disperse vapors, but do not spray directly on spills. For small dry spills, avoid excess dust generation by carefully scooping or vacuuming (with appropriate filter) into a suitable container (above 60 °C sodium hydroxide corrodes steel) for later disposal. For large dry spills, cover with plastic sheet or other impermeable layer and contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

**Environmental Transport:** Sodium hydroxide is not mobile in solid form, although it absorbs moisture very easily. Once liquid, sodium hydroxide leaches rapidly into soil, possibly contaminating water sources.

**Environmental Degradation:** Ecotoxicity values: TLM, mosquito fish, 125 ppm/96 hr (fresh water); TLM, bluegill, 99 mg/48 hr (tap water).

**Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**

Listed as a RCRA Hazardous Waste (40 CFR 261.22): Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance\* (40 CFR 302.4), Reportable

Quantity (RQ): 1000 lb (454 kg) (\* per Clean Water Act, Sec. 311 (b)(4))

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

**Section 8. Special Protection Data**

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.

**Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select the respirator based on its suitability to provide adequate worker protection for the given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent any skin contact.

**Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.<sup>(18)</sup>

**Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

**Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing.

Remove this material from your shoes and clean personal protective equipment.

**Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

**Section 9. Special Precautions and Comments**

**Storage Requirements:** Avoid physical damage to containers. Store in dry, well-ventilated area away from water, acids, metals, flammable liquids, and organic halogens. Keep containers tightly closed since sodium hydroxide can decompose to sodium carbonate and carbon dioxide upon exposure to air. Since corrosion occurs easily above 140 °F (60 °C), do not store or transport sodium hydroxide in aluminum or steel containers at temperatures near this level. Store containers in rooms equipped with trapped floor drains, curbs, or gutters.

**Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control hazardous contaminants and to maintain concentrations at the lowest practical level.

**Other Precautions:** Consider preplacement and periodic medical examinations of exposed workers that emphasize eyes, skin, and respiratory tract. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Inform employees of the possible hazards in using sodium hydroxide.

**Transportation Data (49 CFR 172.101, .102)**

**DOT Shipping Name:** Sodium hydroxide; dry, solid, flake, bead or granular

**DOT Hazard Class:** Corrosive material

**ID No.:** UN1823

**DOT Label:** Corrosive

**DOT Packaging Exceptions:** 173.244

**DOT Packaging Requirements:** 173.245b

**IMO Shipping Name:** Sodium hydroxide, solid

**IMO Hazard Class:** 8

**ID No.:** UN1823

**IMO Label:** Corrosive

**IMDG Packaging Group:** II

**MSDS Collection References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 143, 146, 148, 149, 153, 159, 161, 163  
**Prepared by:** M Gannon, BA; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD; Edited by: ER O'Connor, MS

# Material Safety Data Sheet

Genium Publishing Corporation

1145 Catalyn Street

Schenectady, NY 12303-1836 USA

(518) 377-8855



Sulfuric Acid

Revision C

Issued: October 1980

Revised: February 1986

## SECTION 1. MATERIAL IDENTIFICATION

**MATERIAL NAME:** SULFURIC ACID, CONCENTRATED

**OTHER DESIGNATIONS:** Oil of Vitriol, Hydrogen Sulfate;  $H_2SO_4$ ; CAS #7664-93-9

**MANUFACTURER/SUPPLIER:** Available from many suppliers, including:

Allied Corporation, PO Box 2064R, Morristown, NJ 07960; Telephone: 800 631-8050

HMIS

H:3

F:0

R:2

PPE: \*

\* See Sect. 8

R 1

I 3

S 4

K 0



## SECTION 2. INGREDIENTS AND HAZARDS

%

### HAZARD DATA

Hydrogen Sulfate ( $H_2SO_4$ )

Water

93-98

Balance\*

8-hr TWA:  $1 \text{ mg/m}^3$

Human, Mist Inhalation,  
TCLo:  $3 \text{ mg/m}^3$ , 24 wk.  
(Toxic Mouth Effects)

Rat, Oral,

LD<sub>50</sub>: 2140 mg/kg

\* Material is obtained by the reaction of  $SO_3$  and water. Can contain low impurity levels, such as 0.02% max of iron as Fe. Properties vary with  $H_2SO_4$  content.

Current OSHA standard and ACGIH (1985-86) TLV. NIOSH has a 10-hr TWA, 40-hr. work week, of  $1 \text{ mg/m}^3$ .

## SECTION 3. PHYSICAL DATA

	93.19% $H_2SO_4$	98.33% $H_2SO_4$	100% $H_2SO_4$
Boiling Point, 1 atm, deg C	ca 281	ca 338	ca 330 (dc)
Specific Gravity (60/60 F)	1.8354	1.84	1.84
Volatiles, % @ 340°C	ca 100	ca 100	ca 100
Melting Point, deg C	ca -34	ca 3	10.4
Water Solubility	Complete Miscible		
Vapor Pressure, mm Hg @ 100°F	<1 (93.19% $H_2SO_4$ ); Deg. Baume ... 66 (93.19% $H_2SO_4$ ) - Density of $H_2SO_4$ is often reported in degrees Baume Be. Formula is Be=145 [145/sp gr for liquids heavier than water].		

**Appearance and odor:** Clear, colorless, hygroscopic, oily liquid with no odor. Mists greater than  $1 \text{ mg/m}^3$  are easily recognizable. Those at  $5 \text{ mg/m}^3$  are distinctly objectionable.

## SECTION 4. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None - Nonflammable	NA	NA	NA	NA

Sulfuric acid is nonflammable; however, it is a strong oxidizing agent and may cause ignition by contact with combustible materials. Small fires may be smothered with suitable dry chemical. Cool exterior of storage tanks of  $H_2SO_4$  with water to avoid rupture if exposed to fire. Do not add water or other liquid to the acid! The acid, especially when diluted with water, can react with metals to liberate flammable hydrogen gas.

Sulfuric acid mists and vapors from a fire area are corrosive (see sect. 5).

Fire fighters must wear self-contained breathing equipment and fully protective clothing.

## SECTION 5. REACTIVITY DATA

Sulfuric acid is stable under normal conditions of use and storage. It does not undergo hazardous polymerization. It is a strong mineral acid reacting with bases and metals. The concentrated acid is also a dehydrating agent, picking up moisture readily from the air or other materials. Hydrogen gas may be generated within a  $H_2SO_4$  container. Vent drums cautiously.

This material reacts exothermically with water. (Acid should always be added slowly to water. Water added to acid can cause boiling and uncontrolled splashing of the acid.) Sulfur oxides can result from decomposition and from oxidizing reactions of sulfuric acid.

Concentrated sulfuric acid is a strong mineral acid, an oxidizing agent, and a dehydrating agent that is rapidly damaging to all human tissue with which it comes in contact. Ingestion may cause severe injury or death. Eye contact produces severe or permanent injury. Inhalation of mists can damage both the upper respiratory tract and the lungs. Sulfuric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

Obtain medical help as soon as possible.\* **SKIN CONTACT:** Immediately flush affected areas with water, removing contaminated clothing while under the safety shower. Continue washing with water and get medical attention.\*

**INHALATION:** Remove to fresh air. Restore breathing. Call a physician immediately. **INGESTION:** Dilute acid immediately with large amounts of milk or water, then give milk of magnesia to neutralize. Never give anything by mouth to an unconscious person. Do not induce vomiting; if it occurs spontaneously, continue to administer fluid. Obtain medical attention as soon as possible.\*

Maintain observation of patient for possible delayed onset of pulmonary edema.

- ## SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Handle major spills by a predetermined plan. Contact supplier for assistance in this planning, in meeting local regulations, and for disposing of large amounts. Notify safety personnel. Provide optimum ventilation; vapors are extremely irritating. Stop leak if you can do so without risk.

Cleanup personnel need protection against inhalation or contact. Keep upwind. Contain spill. Minor leaks or spills can be diluted with much water and neutralized with soda ash or lime. If water is not available, cover contaminated area with sand, ashes, or gravel and neutralize cautiously with soda ash or lime.

**DISPOSAL:** Follow Federal, state, and local regulations. Runoff to sewer may create hydrogen gas, which is a fire or explosion hazard. EPA (CWA) RO 1000 lbs. (40 CFR 117).

Provide general ventilation to meet current TLV requirements in the workplace. Where mists are up to  $50 \text{ mg/m}^3$ , a high-efficiency particulate respirator with full facepiece is warranted; a type-C supplier-air respirator with full facepiece operated in pressure-demand mode is used to  $100 \text{ mg/m}^3$ .

Avoid eye contact by use of chemical safety goggles or face shield where splashing may occur. Acid-resistant protective clothing, such as rubber gloves, aprons, boots, and suits, is recommended to avoid body contact.

Eyewash fountain and safety showers with deluge type of heads should be readily available where this material is handled or stored.

**Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.**

Comprehensive preplacement and annual medical examinations with emphasis on dental erosion, cardiopulmonary system, and mucous membrane irritation and cough are indicated.

Sulfuric acid in carboys or drums should be stored in clean, ventilated storage areas having acid-resistant floors with good drainage. Keep out of direct sunlight, do not store above 89.6°F (32°C). Storage facilities are to be separate from organic materials, metallic powders, chromates, chlorates, nitrates, carbides, oxidizables, etc. Soda ash, sand, or lime should be kept in general storage or work areas for emergency use. Protect containers against physical damage. Glass bottles need extra protection. Sulfuric acid is highly corrosive to most metals, especially below 77% H<sub>2</sub>SO<sub>4</sub>. Avoid breathing mist or vapors. Avoid contact with skin or eyes. Do not ingest. Do not add water to concentrated acid. Drums may contain hydrogen gas, so open cautiously. Use nonsparking tools free of oil, dirt, and grit and vapor-proof electrical fixtures

DOT Classification: Corrosive Material

ID No.: UN1830

**Label: Corrosive**

Data Source(s) Code: 1-12, 19, 20, 24, 26, 31, 37-39, 42, 82. CK

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Approvals *[Signature]* 6/86.

### Indust. Hygiene/Safety

## Medical Review